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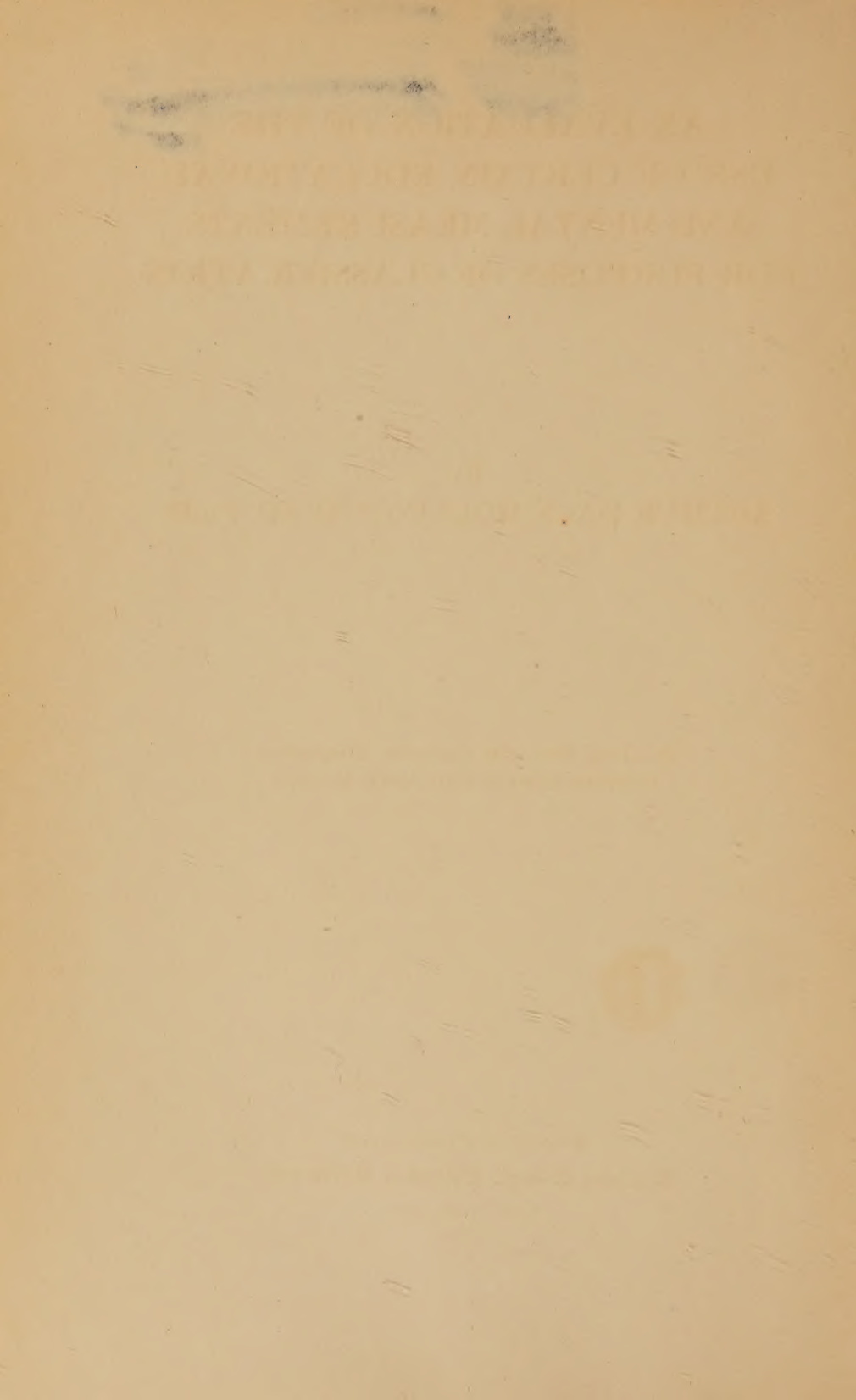
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AN EVALUATION OF THE
USE OF CERTAIN EDUCATIONAL
AND MENTAL MEASUREMENTS
FOR PURPOSES OF CLASSIFICATION

By
ARTHUR DACK HOLLINGSHEAD, Ph.D.

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A.D.H.

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AN EVALUATION OF THE USE OF CERTAIN EDUCATIONAL AND MENTAL MEASUREMENTS FOR PURPOSES OF CLASSIFICATION

CHAPTER I

INTRODUCTION

The development of mass education and the increased demand for equal educational opportunities on the part of the masses within the past century has forced school administrators to devise some scheme which would enable them to teach large numbers of children in the most economical manner possible. From the chaos of the ungraded school was developed the plan of grouping children into classes of thirty or more and teaching all of them the same subject matter of the various elementary school subjects. This plan succeeded in bringing order and in establishing a more economical organization for the teaching of large numbers, but it resulted in the submergence of the individual in the mass. Courses of study and classes, rather than the needs and demands of the individual pupil, became the units of educational thinking. Subject matter was blocked off into portions in a logical order to correspond with the grades and became stratified into courses of study, largely because of the demands of logical sequence and tradition.

This grade system of classification was adopted because of expediency and not as a result of any scientific inquiry or investigation. This plan of placing thirty or more pupils in the same class and teaching them the same subject matter presupposed a homogeneity of ability and achievement in reference to all subjects that were being taught. The classification and promotion of pupils were based largely upon the only numerical measures which the school administrator possessed, namely, the chronological age of the pupils and the teachers' marks on his work. Theoretically, the pupils were supposed to have mastered all

2 Use of Certain Educational and Mental Measurements

portions of the various subjects for that particular grade before they were promoted to the next grade. The teacher's judgment expressed in the form of marks was accepted as determining the basis of promotion.

Beginning with Dr. J. M. Rice's¹ protest against waste in education in 1896-97, there has been an increasing demand for a critical and scientific evaluation of our educational program in all of its phases. The New York School Report of 1904 showed that 15 per cent of the pupils failed of promotion. Strayer, in 1905, showed that in 133 cities with a population of 25,000, or over, 38 per cent of the boys and 32 per cent of the girls were over-age, while only 4 per cent of the pupils were under-age. Thorndike, in 1907, evaluated the efficiency of the schools by studying the number of pupils eliminated.² Ayres published his important study on retardation in 1909.³ Kelley demonstrated the unreliability of school marks in 1913.⁴ These and other studies indicated that there was lacking a proper adjustment between pupil and school and that the bases of classification being used were inadequate. This waste in terms of money and pupil development has demanded a complete revision of our schemes of classification, based upon the results of scientific investigations.

Modern educational practice may, therefore, be characterized by its increasing attempt to base its operation upon scientifically obtained results, rather than upon subjective judgments. The measurement movement may, therefore, be considered the most important educational achievement of the past quarter of a century. It has completely revolutionized school thought and procedure. It has forced the recognition of individual differences in terms of ability and achievement. It has focused the attention of school administrators upon the problem of devising some scheme of classification that will secure a better adjustment between pupil and school. The individual pupil, rather than the subject matter to be studied, is now being considered as the starting point in the educational process. School administrators

¹ Rice, J. M. "Futility of the Spelling Grind." *The Forum*, 23, April, 1897, pp. 163-172, June, 1897, pp. 409-419.

² Thorndike, E. L. *The Elimination of Pupils from Our Schools*. U. S. Bureau of Education Bulletin, No. 4, 1907.

³ Ayres, L. P. *Laggards in Our Schools*. New York Charities Publication Committee, 1909.

⁴ Kelley, F. J. *Teachers' Marks*. Teachers College, Columbia University, Contributions to Education, No. 66, 1914.

are now concerned with adjusting the course of study to meet the needs and capacities of the child rather than with forcing every pupil to master a prescribed course of study. Pupil failures are being considered as representative of failures in administration and as evidence that the proper adjustment between the pupil and school has not been made.

This measurement movement has, however, been very rapid in its development. Educational measurements are a product of the past twenty years. Stone⁵ in 1908 devised his first reasoning test in arithmetic. S. A. Courtis issued his first arithmetic tests in 1909-1910.⁶ Thorndike,⁷ in the same year, produced his scale for measuring the quality of handwriting. Since this date, tests have been devised to measure practically all elementary and secondary school subjects. The mental-group test which is now being used extensively as a basis of classification originated during the World War. This measurement movement has developed with such rapidity and met with such universal acceptance on the part of school administrators that there has been little time for evaluating or checking the effectiveness of the tests in their actual operation as bases in classifying pupils.

Recently, there has been a tendency to subject this whole measurement program to a very critical evaluation. Investigations have been made correlating and comparing the scores made by the same pupils on different intelligence group tests. The following summary based upon an investigation by King of the scores of 184 seventh-grade pupils on the Dearborn, Haggerty, National and Terman Group Tests is representative of the conclusions being reached: "When among a group of children, for example, there are found 40 per cent with individual scores falling in the first quarter of two tests, and the second, third, or fourth quarter of the other two tests; or falling in the first quarter of two tests, and the second and third quarters of two tests; or in the first, second, third, and fourth quarters of four different group intelligence tests, the question of the reliability of any one kind of test or performance must be given serious consideration.

⁵ Stone, C. W. *Arithmetical Abilities*. Teachers College, Columbia University, Contributions to Education, No. 19, 1908.

⁶ Courtis, S. A. *Elementary School Teacher*, 10: 58-74, 177-199; 11: 171-185, 360-370, 528-539; 12: 127-137.

⁷ Thorndike, E. L. "Handwriting." *Teachers College Record*, Vol. 11, No. 2, pp. 1-67, March, 1910.

Since group intelligence tests are being used quite extensively by administrators of schools to classify or grade children according to ability or capacity, one must certainly emphasize caution in their exclusive use for such purposes."⁸

Evaluations of the results of using the results of mental tests in classification have been made in the Detroit and Trinidad school systems. The results show improvement in instructional efficiency over the old methods of classification on the bases of chronological age and teachers' marks.⁹

In an effort to secure an adequate basis for prognostication¹⁰ several isolated investigations have been made evaluating various educational and mental measurements in prophesying school success. Others have evaluated the use of the educational and accomplishment quotients as bases in classifying the pupil's grade on the basis of educational age.^{11, 12} None, however, has attempted to determine the relative effectiveness of the measures under investigation as bases in securing a more homogeneous classification of pupils.

This investigation is not concerned with evaluating these tests from the standpoint of their validity or reliability but, rather, with determining the relative effectiveness of these measures as bases in securing homogeneity in classification. This study, therefore, purposes to evaluate the following measures from an administrative standpoint:

1. As bases in grade placement:
 - a. Mental Age of the National Intelligence Test.
 - b. Educational Age of the Stanford Achievement Test.
 - c. Arithmetic Age of the Stanford Achievement Test in a departmentalized system of classification.
2. As bases in classifying the pupils within a grade into X, Y, and Z sections:
 - a. Intelligence quotient.
 - b. Mental age.

⁸ King, L. A. "A Comparative Study of Group Intelligence Tests." *Eighth Annual Schoolmen's Week Proceedings*, pp. 78-92.

⁹ Corning, Hobart M. *After Testing—What?* Scott, Foresman and Company.

¹⁰ Spain, C. L. "Procedure in Detroit." *Ninth Annual Schoolmen's Week Proceedings*, pp. 258-261.

¹¹ Courtis, S. A. *Why Children Succeed*. S. A. Courtis Tests Publishing Co., Detroit, Mich., 1926.

¹² Beeson and Tope. "Classification of Pupils by E. Q. and A. Q." *Journal Educational Research*, 9: 281-92.

- c.* Educational quotient.
- d.* Educational age.
- e.* "Brightness average," representing an average of the intelligence and educational quotients.
- f.* Accomplishment quotient.
- g.* Arithmetic quotient in the evaluation of the arithmetic age.

CHAPTER II

CONDITIONS OF THIS INVESTIGATION

This investigation is based upon the results of mental and educational tests from the elementary schools of Easton, Pennsylvania. Results were secured for those pupils who had completed the fifth grade at the close of the school year 1923-1924, and had been in the sixth grade during the school year 1924-1925. This group numbered 425 pupils from thirteen classes in the twelve elementary schools of the city.

During the school year 1922-1923, a plan of classification and promotion based upon educational and mental measurements had been inaugurated throughout the elementary grades. This plan was based upon results from the Stanford Achievement Test and the following mental group tests for their respective grades: Haggerty for grades one, two, and three; National for grades four, five, and six; and the Terman Group Test for the seventh and eighth grades. These tests were given and scored by the supervisor of the elementary grades and the head of the research department. Both were well trained in the field of educational and mental measurements, and had had several years experience in giving and scoring tests. The tests were all given about May 1 of each year and the results were used in promoting and classifying pupils for the next year's work.

Classification of pupils was done by the superintendent of schools and the supervisor of the elementary grades upon consideration of the following data for each pupil: chronological age, mental age, intelligence quotient, educational age, educational quotient, gain in educational-age months during the past year, reading age, arithmetic age, promotion record of the past year, health record, and the recommendation of the teacher. The enrollment within the separate elementary schools was too small to permit ability sectioning within the grades. The teachers were advised as to the test results of their pupils and were instructed to adapt the subject matter to their ability and achieve-

ment. The worst cases of the mentally subnormal were placed in ungraded classes.

Table I presents a summary of the various measurements of May 1, 1924, for these fifth-grade classes. The table shows that the 425 pupils were scattered over a range of more than seven years in mental and chronological ages, and approximately six years in reading and arithmetic achievement. The fifth-grade standards in the twelve schools lacked uniformity when measured by the medians of the various measures. In chronological age there was a range of 17 months in the medians of these classes—from 10 years 5 months to 11 years 10 months. The range in the medians of the mental age was 15 months—from 10 years 6 months to 11 years 9 months. These represent differences between classes of the same grade which are as great as those which theoretically should exist between grades. The medians of the intelligence quotients ranged from 91 to 108. In educational achievement, as measured by the educational age, there was present a range of only 8 months—from 11 years 4 months to 12 years 0 months. This indicates that the classification of the preceding year had been based largely upon the educational age of the Stanford Achievement Test. The ranges in achievement in the medians of arithmetic and reading individually were 11 and 12 months, respectively.

When the membership of these fifth-grade classes was considered separately it showed that pupils of a wide range of ability and achievement as measured by the mental and educational tests were classed together. Using the class of 36 pupils from the School A as an illustration, in mental age there was a range of six years eight months, i.e., from 8 years 11 months to 15 years 7 months. In mental ability as measured by the intelligence quotient there was a range from 65 to 150. The educational-age range was four years—from 10 years 0 months to 14 years 0 months. In terms of achievement in arithmetic, these 36 pupils were scattered over a range of 63 months and in reading they were scattered over a narrower range, 46 months. The chronological-age range was nearly six years—from 9 years 11 months to 15 years 9 months.

Thus, there had been included within the same class, for purposes of instruction, pupils varying in mental and chronological age who would normally be in the third grade to those who would

TABLE
CLASS RANGES, MEDIANS, AND SEMI-INTER-QUARTILE

School	N	M. A. '24			I. Q. '24			C. A. '24		
		Range	M.	Q.	Range	M.	Q.	Range	M.	Q.
A.....	36	8:11-15:7	11:8	7.5	65-150	98	16.0	9:11-15:9	10:5	13.0
B.....	33	7: 8-13:6	11:3	6.4	68-132	99	11.5	9:11-15:1	11:1	7.5
C.....	30	8: 6-14:10	11:5	12.0	68-136	95	13.5	9:10-15:4	11:4	9.5
D.....	28	8:11-13:1	11:1	10.0	72-134	94	10.0	8: 5-14:2	10:10	13.0
E-1.....	33	10: 1-12:5	11:3	3.0	75-116	96	8.0	10: 3-13:11	11:6	10.0
E-2.....	29	9: 1-13:10	11:6	6.0	68-140	102	13.0	9: 4-14:9	11:1	14.5
F.....	40	8: 4-13:9	11:2	9.5	70-128	97	9.0	9:10-15:4	11:5	14.0
G.....	32	7:11-13:0	10:6	12.0	66-117	91	9.0	10:5-13:7	11:3	7.0
H.....	40	9: 1-14:6	11:3	8.5	66-153	99	14.0	9: 6-15:7	11:0	13.0
I.....	36	8:10-13:4	11:0	5.5	63-135	97	8.0	9: 1-14:0	10:9	4.5
J.....	17	8: 6-13:10	10:10	8.0	70-136	98	8.0	9: 7-15:7	11:0	8.5
K.....	37	9: 0-14:0	11:9	9.5	69-132	108	9.0	9: 4-13:9	10:8	4.0
L.....	34	8: 5-12:10	11:0	9.5	66-115	92	9.5	10: 1-13:10	11:10	10.0
Total....	425	8: 4-15:7	11:3	8.4	61-155	98.6	12.2	8: 5-15:9	11:4	10.3

The colon is used in these tables to denote the division between years and months, and 11 months; 7.5 is to

normally be in the seventh and eighth grades. Pupils varying in intellectual ability from subnormality to near genius as expressed by the intelligence quotient were also included. In terms of educational achievement, pupils from the fourth- to the sixth-grade status were included in the same class.

This lack of homogeneity in class groupings and uniformity in grade standards indicated that the proper adjustment between the pupils and the curriculum was lacking. If in this investigation the relative effectiveness of the measures under consideration is to be determined, a comparable age span for these measures must be selected which is normal for the subject matter and instruction of the particular grade.

It was, therefore, first considered advisable to limit the study to those pupils in the fifth grade who fell within the normal age span of one year, but this would have eliminated nearly two-thirds of the pupils in terms of mental age, and limited the pupils to too small a number for investigation. By increasing the age span to include that eighteen months' period which contained the greatest number of cases, approximately the middle 50 per cent of the pupils in mental age was selected. It can therefore be assumed that both subject matter and instruction were adjusted to this middle group.

I

DEVIATIONS IN EDUCATIONAL AND MENTAL MEASUREMENTS

E. A. '24			R. A. '24			A. A. '24			Marks '24		
Range	M.	Q.	Range	M.	Q.	Range	M.	Q.	Range	M.	Q.
10: 0-14:0	11:5	4.7	10: 0-13:10	11:3	7.5	9:11-15:2	11:9	6.5	74-89	81	3.0
10: 0-13:9	11:8	4.8	9: 7-14:3	11:9	5.0	10: 4-14:0	11:11	4.0	61-95	80	5.5
10: 0-12:6	11:5	7.0	10: 2-13:6	11:5	9.0	9:10-13:7	11:9	3.5	56-92	78	7.0
10: 6-12:9	11:6	5.7	9: 1-13:8	11:1	6.5	10: 2-14:6	11:8	7.0	60-88	75	4.5
10: 6-12:9	11:7	4.5	9:10-13:2	11:5	5.5	10: 4-14:6	12:7	8.0	58-91	79	7.5
10: 6-13:6	11:6	6.6	10: 7-15:0	12:1	9.0	10: 6-13:2	12:2	8.0	57-89	76	6.0
10: 3-12:9	11:4	6.3	9: 0-13:7	11:5	9.0	10: 2-14:0	11:8	7.0	61-92	68	4.5
10: 0-13:0	11:4	5.7	10: 1-12:9	10:10	8.0	10: 6-14:0	11:11	10.0	60-89	77	6.0
9:10-13:3	11:7	5.8	9:10-14:0	11:6	7.0	9:11-15:4	12:0	11.5	63-94	76	2.5
10: 3-13:3	11:8	3.9	9: 7-12:11	11:9	5.5	10: 8-14:6	12:0	5.5	69-95	80	2.5
10: 3-13:0	11:6	6.0	9: 8-13:8	11:0	10.0	9:11-14:0	11:11	5.0	70-95	80	2.5
10: 6-13:0	12:0	7.8	9: 8-13:8	11:10	10.0	10: 4-14:6	12:2	9.0	68-95	80	5.0
10: 3-13:3	11:4	6.0	9: 8-13:4	11:1	5.0	10: 4-13:2	11:11	4.0	61-93	77	7.5
9:10-14:0	11:6	5.9	9: 0-15:0	11:7	8.0	9:10-15:4	12:0	5.3	56-95	78.8	5.5

and the decimal point, the months and tenths of months—8:11 is to be read: 8 years be read: 7 and $\frac{5}{10}$ months.

This study does not propose an eighteen months' age span as a basis of classification to be used in actual practice. It is being used in this study for the reasons which are given above.

CHAPTER III

MENTAL AGE AS A BASIS FOR CLASSIFICATION

Intelligence tests were first used in differentiating the inferior or the subnormal child. They were first developed in the form of individual tests which required approximately an hour to give. This prevented their application to the schoolroom by not meeting the larger problem of classifying all pupils in relation to their mental ability. The development of the mental-group test, which was a by-product of the World War, placed in the hands of school administrators a new tool for securing a measure of the intelligence of all pupils.

Research bureaus have been established in the more progressive city school systems and thousands of pupils are being tested annually and classified on the results of mental tests. Mental ability has been assumed to be the determining factor in school success and, therefore, the results of mental tests in the form of mental age and intelligence quotient have been used as bases for segregating pupils into grades and sections of a similar mental ability. Mental age has been used as a basis for classifying pupils into grades, and the intelligence quotient has been used to group into sections pupils within the same grade who have similar intellectual ability. Investigations¹ have shown that these measures give a more accurate classification than teachers' judgments, school marks, or chronological age.

It was considered advisable to determine first the extent to which the heterogeneity of the total fifth-grade group might be reduced by using the mental age and the intelligence quotient as bases in differentiating the total group into ability sections. The plan of classifying pupils into fast, average, and slow sections by dividing them into 20 per cent, 60 per cent, and 20 per cent sections was used. These sections will be designated throughout this investigation as the X, Y, and Z sections, respectively.

These sections of the total fifth-grade group were then assumed

¹ Corning, Hobart M. *After Testing—What?* Scott, Foresman and Company.

to have been promoted into the sixth grade. A comparison of the range, dispersion, and overlapping in reading and arithmetic at the beginning and at the end of the year's work was made to determine the relative effectiveness of these measures in reducing the heterogeneity of the total group.

Overlapping in this investigation was considered present when a portion of a section exceeded or fell below the average in achievement of other sections. Those pupils of the Z section who achieved above the average of the Y group were considered to be overlapping. The Y pupils who were either below the average of the Z section or above the average of the X section were classified as overlapping. Overlapping was considered present for the X pupils when their achievement was less than that for the Y section. The total percentage of overlapping was determined by adding the pupils of the various sections who exceeded or fell below the averages of the other sections and then dividing by the total number of pupils. The percentage of overlapping therefore indicates the extent to which these measures divide this mental-age group into well-defined sections of ability, as well as the extent to which they differentiate sections that progress at the same rate during the year's work.

Differentiation of the total group into X, Y, and Z sections on the basis of mental age reduced the range in reading for the total group from 72 months to ranges in the individual sections of 40, 52, and 48 months in 1924. The dispersion of the total group was reduced from a standard deviation of 12.6 months to 8.3, 10.3, and 9.7 months for the X, Y, and Z sections, respectively. The ranges of the separate sections were increased during the year's work to 48, 64, and 60 months, whereas the range of the total group remained at 72 months. The dispersion of the sections was increased to standard deviations of 11.5, 12.3, and 12.8 months, and the dispersion of the total group was increased to 14.7 months. (See Table II.)

In arithmetic there was present in the 1924 total fifth-grade group a range of 68 months with a standard deviation of 11.6 months. This was increased during the year's work to a range of 90 months and a standard deviation of 17.1 months. The sections in arithmetic secured by differentiation upon the basis of mental age possessed ranges of 44, 56, and 56 months in 1924, and 60, 85, and 75 months at the close of the year's work. The

TABLE II
RESULTS OF SECTIONING THE TOTAL GROUP ON THE BASIS OF MENTAL AGE
INTO X, Y, AND Z SECTIONS

READING								
	R. A. '24	R. A. '25	Z '24	Z '25	Y '24	Y '25	X '24	X '25
Range....	9:0-15:0	10:0-16:0	9:0-12:4	10:0-14:0	9:4-13:8	10:0-15:4	10:4-14:4	11:0-16:0
Range in Months.	72	72	40	48	52	64	48	60
Average..	11:7.6	12:8.0	10:9.2	11:7.8	11:7.6	12:7.5	12:7.2	13:10.0
S. D.	12.6	14.7	8.8	11.5	10.3	12.3	9.7	12.8
Gain	12.4		10.6		11.9		14.8	

ARITHMETIC								
	A. A. '24	A. A. '25	Z '24	Z '25	Y '24	Y '25	X '24	X '25
Range....	9:8-15:4	10:2-17:8	9:8-13:4	10:2-15:2	9:8-14:4	10:7-17:8	10:4-15:0	11:5-17:8
Range in Months.	68	90	44	60	56	85	56	75
Average..	12:1.0	13:3.3	11:5.5	12:7.3	12:0.6	13:7.5	12:9.6	14:10.7
S. D.	11.6	17.1	10.0	12.4	10.2	14.8	11.8	16.7
Gain	19.3		13.8		18.9		25.1	

standard deviations for these sections were 11.3, 10.2, and 10.0 months for 1924 and 16.7, 14.8, and 12.4 months for 1925.

Table III shows the results secured from classifying the total group into X, Y, and Z sections on the basis of the intelligence quotient. The sections in reading possessed ranges of 60, 56, and 36 months in 1924 and 56, 64, and 60 months in 1925. The standard deviations for these sections were 9.5, 10.5, and 8.0 months in 1924 and 11.8, 12.4 and 12.1 months at the close of the year. Almost the same differences in the homogeneity of the arithmetic sections were secured.

The percentage of overlapping, as shown in Table IV, which resulted from sectioning the total group upon the basis of mental age was 23 in reading at the beginning and at the close of the year. In arithmetic the percentage remained constant at 32 during the year's work. This was a much smaller percentage of overlapping than was secured when mental age was first used as a basis for grade placement and again as a basis for sectioning as shown in Table XIIB. This plan resulted in an overlapping of 45 and 49 per cent in reading and of 59 and 46 per cent in arithmetic for the years 1924 and 1925, respectively. This decrease in the percentage of overlapping was not occasioned by securing

TABLE III

RESULTS OF SECTIONING THE TOTAL GROUP ON THE BASIS OF THE INTELLIGENCE QUOTIENT INTO X, Y, AND Z SECTIONS

READING								
	R. A. '24	R. A. '25	Z '24	Z '25	Y '24	Y '25	X '24	X '25
Range....	9:0-15:0	10:0-16:0	9:4-12:4	10:0-15:0	9:0-13:8	10:0-15:4	11:0-15:0	11:4-16:0
Range in Months..	72	72	36	60	56	64	60	56
Average..	11:7.6	12:8.0	10:10.2	11:8.7	11:7.1	12:7.0	12:8.7	13:10.2
S. D.	12.6	14.7	8.0	12.1	10.5	12.4	9.5	11.8
Gain	12.4		10.5		11.9		13.5	

ARITHMETIC								
	A. A. '24	A. A. '25	Z '24	Z '25	Y '24	Y '25	X '24	X '25
Range....	9:8-15:4	10:2-17:8	9:8-13:8	10:2-16:5	9:8-14:4	10:2-17:8	10:0-15:0	11:0-17:8
Range in Months..	68	90	48	75	56	85	60	80
Average..	12:1.0	13:8.3	11:6.2	12:9.5	12:1.0	13:7.1	12:8.9	14:10.2
S. D.	11.6	17.1	12.6	15.5	10.2	14.3	12.1	17.6
Gain	19.3		15.3		18.1		25.3	

TABLE IV

EXTENT OF OVERLAPPING OF THE TOTAL GROUP CLASSIFIED INTO X, Y, AND Z SECTIONS ON THE MENTAL-AGE AND INTELLIGENCE-QUOTIENT BASES

SECTION		READING								ARITHMETIC							
		M. A.				I. Q.				M. A.				I. Q.			
		'24		'25		'24		'25		'24		'25		'24		'25	
		N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Z	+y	9	11	14	16	6	7	15	18	17	20	17	20	20	24	23	27
	+x	0	0	2	2	0	0	3	3	5	6	2	2	8	9	5	6
Y	-z	38	15	45	18	47	19	65	25	54	21	71	28	55	22	74	29
	+x	38	15	29	11	30	12	27	10	43	17	35	14	39	15	33	13
X	-y	11	13	10	12	11	13	5	6	20	24	16	19	22	26	16	19
	-z	1	1	2	2	0	0	2	2	5	6	5	6	7	8	10	12
Total Overlapping		23		23		22		24		32		33		32		34	

M. A. = Mental age.

I. Q. = Intelligence quotient.

+ y = Above average of Y section.

+ x = Above average of X section.

- y = Below average of Y section.

- z = Below average of Z section.

a greater degree of homogeneity, but is due rather to the greater difference between the averages of the various sections. The difference between the X and Y sections of the total group in reading was 11.6 months and between the Y and Z sections, 10.4

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months. The corresponding differences between the averages of the mental-age group in reading were 7.4 and 3.5 months.

This section of the investigation represents an attempt to evaluate the use of these measures as bases for classifying pupils into grades and then for placing the pupils within the grades into ability sections. It was assumed that the mental age of the National Intelligence Test was used as a basis for classification in grade placement. The eighteen months' span as defined in the previous section was used as the age span for this grade, and all pupils who were between the mental age of 11 years 0 months and 12 years 6 months were considered as having been placed in a grade just beginning the sixth-grade work. This group consisted of 219 pupils with an average mental age of 11 years 8.4 months and a standard deviation of 5.5 months.

TABLE V
COMPARISONS OF MENTAL-AGE GROUP WITH THE OTHER MEASURES
N 219

	M. A.	E. A.	C. A.	R. A.	A. A.	E. Q.	I. Q.
Range	11:0-12:6	10:4-13:7	8:10-15:7	9:7-14:3	10:3-14:6	71-146	70-135
Range in Months	18	39	81	56	51	75	65
Average	11:8.4	11:9.8	11:4.4	11:11.3	12:4.6	106.2	104.8
S. D.	5.5	7.8	14.0	10.7	10.1	14.5	12.3

The colon is used in these tables to denote the division between years and months, and the decimal point, the months and tenths of months—11:8.4 is to be read: 11 years 8 and 4/10 months.

A study of the other measures of this group for May 1, 1924, presents a tremendous lack of homogeneity in terms of chronological age, intellectual ability, and educational achievement. The chronological age of this mental-age group varied from pupils of 8 years 10 months to those of 15 years 7 months with a standard deviation of 14 months. The educational ages of these pupils were scattered over a range of 39 months—from 10 years 4 months to 13 years 7 months with a standard deviation of 7.8 months. The educational quotient, a measure of the rate of progress educationally, covered a range from dull to brilliant—from an E.Q. of 71 to one of 146. In mental ability as measured by the intelligence quotient there was nearly the same range, although the average was somewhat lower, being 104.8 with a standard deviation of 12.3. There was present within this mental-age group a wide range of achievement in

both reading and arithmetic. Pupils ranging in reading age from those who were normal for the third to the seventh grades, inclusive, were included within this mental-age group. In arithmetic they were scattered over a range of 51 months—from 10 years 3 months to 14 years 6 months, with an average arithmetic age of 12 years 4.6 months and a standard deviation of 10.1 months. The reduction of the mental age from 87 months for the total fifth-grade group to the eighteen months' period for this study did not, therefore, greatly reduce the ranges and dispersion of the other measures of ability and achievement. The range in educational age was reduced from 50 to 39 months and the standard deviations from 8.8 to 7.8 months. The reading-age range was reduced from 72 to 56 months and the standard deviation from 11.9 to 10.7; the arithmetic-age range was reduced from 66 to 51 months; and the standard deviation from 10.2 to 10.1 months. The intelligence quotient was reduced in its range from 94 to 65 points, and in standard deviation from 18.2 to 12.3. Thus, it is seen that using the mental age alone as a basis of classification did not segregate pupils into homogeneous groups in reference to the other measures of ability and achievement.

In order to secure a more homogeneous grouping of pupils who have been classified into the same grade by the use of the mental age as a basis, various plans of grouping pupils within the same grade into three or more sections on the bases of various measures of ability have been developed. Four different measures have been proposed as bases for sectioning pupils into ability groups: (1) The intelligence quotient, an index of the pupil's mental development in relation to his chronological age, (2) the educational quotient, an index of the pupil's rate of progress educationally in respect to his chronological age, (3) a "brightness average," representing the average of the intelligence and educational quotients, and (4) the accomplishment quotient, an index of the rate of educational growth in relation to mental development.

These various plans of classification have for their main objective the securing of more homogeneous sections for instructional purposes. This sectioning demands homogeneity in terms of educational status in the subjects to be taught plus homogeneity of ability to progress at the same rate in these subjects

during the year's work. The relative effectiveness of these various measures as bases for sectioning was determined by comparing the following measures of homogeneity at the beginning and at the end of the year: (1) The ranges in reading and arithmetic in the sections, (2) the dispersion of the sections in these subjects as measured by the standard deviation, (3) the number of month's gain in reading and arithmetic, and (4) the percentage of overlapping existing between the various sections in these two subjects.

Using the above measures as bases, this mental-age group was divided into three sections. These sections, as differentiated by the measures for May, 1924, were then assumed to have been promoted into the sixth grade. Tables VI through X present the results of applying these various plans of classification to this mental-age group.

It is noticeable that for the total mental-age group, there is a marked increase in the ranges of achievement and the standard deviations during the sixth-grade work in reading and arithmetic. The total range for reading was increased from 56 to 63 months; for arithmetic, from 51 to 80 months. The standard deviations were increased from 10.7 months to 12.5 months for reading, and from 10.1 to 15.8 months for arithmetic, that is, the pupils who had been classified by the use of mental age into an eighteen months' range group were scattered in achievement at the end of the year's work over a range of 63 months in reading and 80 months in arithmetic. In reading, the middle 68.26 per cent (one standard deviation on either side of the average) was included within a range of 25 months and, in arithmetic, the range of the middle 68.26 per cent was 31.6 months. This indicates that, if there is to be homogeneity in subject achievement, there must be frequent reclassifications or the provision of an enriched curriculum for those pupils who exceed the achievement standards for their grades.

Considering the intelligence quotient as a basis for sectioning this mental-age group, Table VI shows that the range of achievement in reading was decreased from that of the total group of 56 months to 32, 44, and 37 months for the X, Y, and Z sections, respectively. The amount of dispersion was also decreased from an S.D. of 10.7 months for the total group to 7.9, 9.7, and 9.2 months for the three groups, respectively. In reading, the aver-

TABLE VI

THE RESULTS OF CLASSIFYING THIS MENTAL-AGE GROUP INTO X, Y, AND Z SECTIONS ON THE BASIS OF THE I.Q. FOR 1924 AND 1925

READING								
	R. A. '24	R. A. '25	Z '24	Z '25	Y '24	Y '25	X '24	X '25
Range....	9:7-14:3	10:6-15:9	9:7-12:8	10:9-15:0	10:0-13:8	10:6-15:3	11:8-14:4	11:9-15:9
Range in Months..	56	63	37	51	44	57	32	48
Average..	11:11.3	13:0.0	11:3.0	12:3.5	11:10.5	12:11.9	12:10.3	13:9.2
S. D.	10.7	12.5	9.2	11.2	9.7	11.1	7.9	11.1
Gain	12.8		12.5		13.4		10.5	

ARITHMETIC								
	A. A. '24	A. A. '25	Z '24	Z '25	Y '24	Y '25	X '24	X '25
Range....	10:3-14:6	11:0-17:8	10:3-13:9	11:8-16:4	10:9-14:6	11:0-17:8	10:3-14:3	11:4-17:8
Range in Months..	51	80	42	56	45	80	48	76
Average..	12:4.6	14:0.9	12:2.3	13:6.6	12:4.3	14:1.6	12:8.1	14:5.3
S. D.	10.1	15.8	9.8	13.2	9.6	14.3	10.1	18.8
Gain	20.3		16.3		21.3		21.2	

ages of these sections correspond quite closely to the differences in intellectual ability existing between the sections—12 years 10.3 months, 11 years 10.5 months, and 11 years 3.0 months for the X, Y, and Z sections. The X section failed to show a gain commensurate with its ability, since in reading its gain in months was less than that of the other two sections.

In arithmetic the intelligence quotient fails to differentiate the mental-age group by sharply defining sections as it did in reading. The averages of the three sections in arithmetic were very close together—12 years 8.1 months, 12 years 4.3 months, and 12 years 2.3 months for the X, Y, and Z sections, respectively. The ranges of the three sections in arithmetic approximate the range of the total group—48, 45, and 42 months, instead of 51 months as in the case of the total group. The dispersion of the sections was much the same as for the total, having standard deviations of 10.1, 9.6, and 9.8 months. During the year's work the range of these individual sections was greatly increased from 48, 45, and 42 months to 76, 80, and 56 months for the X, Y, and Z sections, respectively. There was also a correspondingly large increase in the standard deviations—10.1, 9.6, and 9.8 months to 18.8, 14.3, and 13.2 months.

The use of the educational quotient, accomplishment quo-

TABLE VII

RESULTS OF CLASSIFYING THIS MENTAL-AGE GROUP INTO X, Y, AND Z SECTIONS ON THE BASIS OF THE E.Q. FOR 1924 AND 1925

READING								
	R. A. '24	R. A. '25	Z '24	Z '25	Y '24	Y '25	X '24	X '25
Range...	9:7-14:3	10:6-15:9	9:7-12:8	10:6-15:0	10:0-13:8	11:0-15:0	11:0-14:4	11:9-15:9
Range in Months.	56	63	37	54	44	48	40	48
Average..	11:11.3	13:0.1	11:2.0	12:2.7	11:10.7	12:11.5	12:10.0	13:10.8
S. D.....	10.7	12.5	10.4	13.3	8.7	10.4	8.5	11.1
Gain	12.8		12.7		12.8		12.8	

ARITHMETIC								
	A. A. '24	A. A. '25	Z '24	Z '25	Y '24	Y '25	X '24	X '25
Range...	10:3-14:6	11:0-17:8	10:3-13:9	11:8-16:4	10:3-14:6	11:0-17:4	11:9-14:6	12:0-17:8
Range in Months.	51	80	42	56	51	76	33	68
Average..	12:4.6	14:0.9	12:2.0	13:7.0	12:3.2	13:11.8	12:11.5	14:9.8
S. D.....	10.1	15.8	10.6	14.7	9.2	13.8	8.3	20.0
Gain	20.3		17.0		20.6		22.3	

R. A. '24 = Reading age for 1924.

R. A. '25 = Reading age for 1925.

A. A. '24 = Arithmetic age for 1924.

A. A. '25 = Arithmetic age for 1925.

TABLE VIII

RESULTS OF CLASSIFYING THIS MENTAL-AGE GROUP INTO X, Y, AND Z SECTIONS ON THE BASIS OF THE "BRIGHTNESS AVERAGE" FOR 1924 AND 1925

READING								
	R. A. '24	R. A. '25	Z '24	Z '25	Y '24	Y '25	X '24	X '25
Range ...	9:7-14:3	10:6-15:9	9:7-12:8	10:6-15:0	10:0-13:8	11:0-15:0	11:0-14:3	11:9-15:9
Range in Months.	56	63	37	54	44	48	39	48
Average..	11:11.3	13:0.1	11:2.9	12:2.3	11:10.3	12:11.9	12:9.8	13:10.3
S. D.....	10.7	12.5	9.2	10.3	8.8	11.0	7.7	11.1
Gain	12.8		11.4		13.6		12.5	

ARITHMETIC								
	A. A. '24	A. A. '25	Z '24	Z '25	Y '24	Y '25	X '24	X '25
Range...	10:3-14:6	11:0-17:8	10:3-13:9	11:8-16:4	10:3-14:6	11:0-17:8	10:9-14:3	12:0-17:8
Range in Months.	51	80	42	56	51	80	42	68
Average..	12:4.6	14:0.9	12:0.1	13:6.6	12:3.5	14:1.0	12:8.9	14:7.0
S. D.....	10.1	15.8	11.4	13.8	9.9	13.0	8.4	15.6
Gain	20.3		18.5		19.5		22.1	

TABLE IX

RESULTS OF SECTIONING THE MENTAL-AGE GROUP INTO X, Y, AND Z SECTIONS ON THE BASIS OF THE ACCOMPLISHMENT QUOTIENT

READING								
	R. A. '24	R. A. '25	Z '24	Z '25	Y '24	Y '25	X '24	X '25
Range...	9:7-14:3	10:6-15:9	10:0-12:3	10:6-14:0	10:0-13:6	11:0-15:6	10:9-14:3	11:9-15:9
Range in Months.	56	63	27	42	42	54	42	48
Average...	11:11.3	13:0.1	11:3.1	12:4.5	11:11.2	12:11.4	12:6.2	13:8.9
S. D.	10.7	12.5	7.7	9.9	9.9	12.4	9.8	11.4
Gain	12.8		13.4		12.2		14.7	

ARITHMETIC								
	A. A. '24	A. A. '25	Z '24	Z '25	Y '24	Y '25	X '24	X '25
Range...	10:3-14:6	11:0-17:8	10:3-13:9	11:0-15:0	10:3-14:0	11:4-17:8	11:9-14:6	12:0-17:8
Range in Months.	51	80	42	48	45	76	33	68
Average...	12:4.6	14:0.9	11:9.9	13:6.4	12:3.4	14:0.7	13:0.5	14:6.9
S. D.	10.1	15.8	10.2	12.8	9.8	14.8	9.9	16.2
Gain	20.3		18.5		21.3		18.4	

TABLE X

RESULTS OF SECTIONING THE MENTAL-AGE GROUP INTO X, Y, AND Z SECTIONS ON THE BASIS OF THE MENTAL AGE

READING								
	R. A. '24	R. A. '25	Z '24	Z '25	Y '24	Y '25	X '24	X '25
Range...	9:7-14:3	10:6-15:9	10:0-12:6	11:3-14:9	10:0-14:3	10:6-15:9	10:9-14:0	11:3-15:6
Range in Months.	56	63	30	42	51	63	39	51
Average...	11:11.3	13:0.1	11:7.5	12:6.6	11:11.0	12:11.1	12:6.4	13:7.8
S. D.	10.7	12.5	6.6	10.6	9.9	11.9	9.2	10.2
Gain	12.8		11.1		12.1		13.4	

ARITHMETIC								
	A. A. '24	A. A. '25	Z '24	Z '25	Y '24	Y '25	X '24	X '25
Range...	10:3-14:6	11:0-17:8	10:3-14:6	12:0-17:8	10:3-14:6	11:0-17:0	10:3-14:0	11:8-17:8
Range in Months.	51	80	51	68	51	72	42	72
Average...	12:4.6	14:0.9	12:2.8	13:8.3	12:2.3	13:10.8	12:10.5	14:11.4
S. D.	10.1	15.8	9.9	14.8	11.7	14.0	11.3	17.8
Gain	20.3		17.5		20.5		24.9	

tient, and the "brightness average" as bases for grouping this mental-age group into ability sections did not change the results appreciably in reference to the range of achievement or the dis-

persion to be found in the separate sections. The educational quotient divided the group into sections in reading that were differentiated a little better in terms of averages, but the standard deviations were much the same as the sections divided on the basis of the intelligence quotient. In arithmetic these measures do not group the pupils into widely differentiated and homogeneous sections, for in each case the range and dispersion of the sections is approximately the same as for the mental-age group when it is considered as a whole.

An attempt was then made to discover if the application of a maturity, rather than an ability, measure would not differentiate this mental-age group into more homogeneous sections. If a pupil with a high educational age was found within this mental-age group, this was considered to indicate that he had educational maturity in respect to others, and that he should, therefore, be placed in the X section; that those with low educational ages were educationally immature and that they should therefore be placed in the Z section. This classification differs from that of the accomplishment quotient in that this plan places the pupils who are educationally more mature in the X section, whereas the accomplishment quotient places the educationally accelerated ones in the X section regardless of their maturity.

TABLE XI

RESULTS OF SECTIONING THE MENTAL-AGE GROUP INTO X, Y, AND Z SECTIONS ON THE BASIS OF THE EDUCATIONAL AGE

READING								
	R. A. '24	R. A. '25	Z '24	Z '25	Y '24	Y '25	X '24	X '25
Range...	9:7-14:3	10:6-15:9	10:0-12:3	10:6-14:0	10:0-13:6	11:0-15:0	11:3-14:3	11:9-15:9
Range in Months..	56	63	27	42	42	48	36	48
Average...	11:11.3	13:0.1	11:0.6	12:1.3	11:10.5	12:11.1	12:11.1	14:1.2
S. D.	10.7	12.5	6.5	9.6	7.6	10.1	7.4	11.2
Gain	12.8		12.7		12.6		14.1	

ARITHMETIC								
	A. A. '24	A. A. '25	Z '24	Z '25	Y '24	Y '25	X '24	X '25
Range...	10:3-14:6	11:0-17:8	10:3-13:0	11:0-15:0	10:3-14:0	11:4-17:4	11:6-14:6	12:0-17:8
Range in Months..	51	80	33	48	45	72	36	68
Average...	12:4.6	14:0.9	11:9.5	13:4.7	12:3.4	14:0.0	13:1.6	15:0.5
S. D.	10.1	15.8	9.0	12.8	9.0	15.0	9.2	17.0
Gain	20.3		17.5		20.6		22.9	

Results of this plan of classification would seem to show that maturity is the better basis for classifying this mental-age group into homogeneous sections. Table XI presents the results in reference to the ranges and dispersion of the sections. This shows that in nearly every instance the ranges of the sections and the dispersions were less than under any other basis.

These various plans of classification were then evaluated from the standpoint of the percentage of overlapping existing between the different sections at the beginning and at the end of the year.

Tables XIIA, B, C shows the percentage of overlapping in arithmetic and reading present at the close of the fifth year's work and again at the close of the next year, in reading and arithmetic. Reading the table in connection with the sections which were classified on the basis of the intelligence quotient, Z section of 1924 shows only 9 pupils above the Y average in reading and none above the X average. This made an overlapping of 20 per cent for the Z section in 1924. At the close of the next year's work in reading, 10 Z pupils had exceeded the Y average, thus increasing the overlapping to 23 per cent. In arithmetic there was present in 1924 in the Z section an overlapping of 36 per cent since 16 or 44 pupils had exceeded the Y average. This percentage was decreased to 34 during the year's work.

Reading Table XII B in summary form, educational age is shown to be the best basis of classification. With this measure as a basis of classification, there was only an overlapping of 10 per cent in reading in 1924 and of 18 per cent in 1925. The next best basis for classification in reading was the educational quotient which resulted in an overlapping of 22 per cent in 1924 and of 24 per cent in 1925. The accomplishment quotient was the poorest basis, with an overlapping of 32 and 31 per cent for the beginning and the end of the year's work, respectively. For arithmetic, educational age also proved to be the best basis. In the sections of 1924 there was present 27 per cent and at the end of the year, 38 per cent. The educational quotient, the next best basis, resulted in 56 per cent in 1924 and 49 per cent in 1925.

Evaluating the use of these various measures in the light of the criteria set up as measures of homogeneity, it is seen that the best basis for sectioning the mental-age group is educational age. It produces sections with smaller ranges, less dispersion,

TABLE XII A

EXTENT OF OVERLAPPING OF THE MENTAL-AGE GROUP CLASSIFIED INTO X, Y, AND Z, SECTIONS ON THE INTELLIGENCE-QUOTIENT, EDUCATIONAL-QUOTIENT, AND "BRIGHTNESS-AVERAGE" BASES

SECTION	READING												ARITHMETIC											
	I. Q.				E. Q.				B. A.				I. Q.				E. Q.				B. A.			
	'24		'25		'24		'25		'24		'25		'24		'25		'24		'25		'24		'25	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Z.....	9	20	10	23	9	20	8	19	10	23	9	20	16	36	15	34	17	37	19	43	15	33	16	34
+y	0	00	2	4	0	00	2	4	0	00	1	2	11	25	11	25	11	25	9	20	10	23	8	17
-z	25	19	28	21	22	17	12	9	26	20	24	19	31	39	51	39	72	55	27	21	46	36	43	34
+x	16	12	28	21	13	10	26	20	14	11	22	17	40	30	39	30	24	18	43	33	36	28	40	31
-y	3	7	8	18	4	9	7	16	3	7	6	14	19	43	19	43	9	20	13	29	14	32	15	33
X.....	0	00	2	4	0	00	2	4	0	00	2	4	10	23	13	29	4	9	9	20	8	18	11	25
-z																								
Total	53	24	76	35	48	22	53	24	53	25	61	28	126	58	125	58	122	56	102	49	111	52	114	54
Overlapping																								

I. Q. = Intelligence quotient.

E. Q. = Educational quotient.

B. A. = "Brightness average," representing average of I. Q. and E. Q.

+ y = Above average of Y section.

+ x = Above average of X section.

- y = Below average of Y section.

- z = Below average of Z section.

TABLE XII B

OVERLAPPING AS A RESULT OF SECTIONING THE MENTAL-AGE GROUP ON THE BASES OF THE MENTAL AND EDUCATIONAL AGES

SECTION		E. A.								M. A.							
		R. A. '24		R. A. '25		A. A. '24		A. A. '25		R. A. '24		R. A. '25		A. A. '24		A. A. '25	
		N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Z....	+y	3	7	7	16	6	14	15	33	8	18	17	39	21	48	18	41
	+x	0	0	1	2	1	2	4	9	2	4	12	27	8	18	6	13
Y....	-z	11	9	21	16	28	22	36	28	52	41	44	33	67	53	49	38
	+x	5	4	9	7	18	14	22	17	27	21	32	25	28	22	22	17
X....	-y	2	4	3	7	7	16	10	23	10	23	12	27	10	23	10	23
	-z	0	0	1	2	0	0	4	9	6	14	7	16	11	25	8	18
Total Overlapping		21	10	40	18	59	27	83	38	97	45	105	49	127	59	99	46

TABLE XII C

OVERLAPPING AS A RESULT OF SECTIONING THE MENTAL-AGE GROUP ON THE BASIS OF THE ACCOMPLISHMENT QUOTIENT

SECTION		R. A. '24		R. A. '25		A. A. '24		A. A. '25	
		N	%	N	%	N	%	N	%
Z	+y	7	16	10	23	11	25	16	36
	+x	0	00	3	07	7	16	8	18
Y	-y	29	23	28	22	33	26	41	32
	+x	20	16	22	16	24	18	43	34
X	-y	12	27	7	16	9	20	17	37
	-z	2	04	2	04	8	18	8	08
Total Overlapping		68	32	67	31	77	36	117	53

and less overlapping than any other measure. If an ability measure is to be used then the educational quotient is superior to the others. The "brightness average," representing an average of the intelligence and educational quotients, occupies in effectiveness a middle position between these quotients.

Summarizing the previous investigation by considering the results of using the most effective basis of sectioning this mental-age group, namely, the educational age, there would have been sections in reading having ranges 36, 42, and 27 months in 1924, and 48, 48, and 42 months in 1925 for the X, Y, and Z sections. The dispersion of these sections would have been 7.4, 7.6, and 6.5 months in 1924 and 11.2, 10.1, and 9.6 months in 1925. The gains for the three sections in reading would have been 14.1, 12.6, and 12.7 months for the X, Y, and Z sections, respectively. In terms of overlapping between the sections in reading there would have been 10 per cent in 1924 and 18 per cent in 1925.

These same sections in arithmetic would have possessed ranges of 36, 45, and 33 months for 1924, and 68, 72, and 48 months in 1925 for the X, Y, and Z sections, respectively. There would have been an overlapping of 24 per cent between these sections in 1924 and of 38 per cent in 1925.

It is recognized that this procedure does not give the actual amount of the ranges, dispersion, and overlapping that would have existed if these sections were taught subject matter adjusted to their differences in ability. Pupils in this study were under a one-track curriculum and adjustments to individual differences were made by the teacher. The total percentage of overlapping, the ranges, and the dispersion probably would have been less if a differentiated curriculum had been in effect. It can, however, be assumed that the same relationships existing between these measures, under the conditions of this study, would have remained the same if these pupils had been taught subject matter adjusted to their sectional differences in ability and achievement; that is, since this investigation has shown the educational age to be the most effective basis of sectioning, this would have been the most effective basis if these pupils had been in a school with a differentiated curriculum.

SUMMARY

The reduction of the mental-age range to 18 months from that of 87 months for the total group did not greatly reduce the ranges and dispersion of the other measures. The range in educational age was reduced from 50 to 39 months, and the standard deviation from 8.9 to 7.8 months. The reading-age range was reduced from 72 to 56 months and the standard deviation from 12.0 to 10.7 months; the arithmetic-age range was reduced from 66 to 51 months; and the dispersion from a standard deviation of 10.2 to 10.1 months. Thus, it is seen that using the mental age as a basis for classification in grade placement does not segregate pupils into homogeneous groups in reference to the measures of educational achievement.

This investigation has shown that educational age is the best basis for placing this mental-age group into more homogeneous sections in terms of ability and achievement in reading and arithmetic. With this measure as a basis of classification there was an overlapping of 10 per cent in reading in 1924 and

of 18 per cent at the end of 1925. In arithmetic there was an overlapping of 24 per cent in 1924 and of 38 per cent in 1925. The next best basis for sectioning this mental-age group was the educational quotient, which resulted in overlapping of 22 and 24 per cent in reading, and of 56 and 49 per cent in arithmetic for the beginning and for the end of the year.

CHAPTER IV

EDUCATIONAL AGE AS A BASIS OF CLASSIFICATION

Educational age has been proposed as a basis of classification, because it immediately realizes the first objective of classification, that of segregating pupils of an equal educational status. Pupils possessing the same educational age are considered to have the same educational status, and therefore should be placed within the same grade. The Stanford Achievement Test Manual states that if pupils in a school were classified on the educational age of the Stanford Achievement Test alone, probably not more than 5 per cent of the twelve-year-olds would be placed in the wrong grade.¹ Educational age is an index of the actual achievement of the pupil, and not the possibility of achievement as it is in the mental age.

The educational age of the Stanford Achievement Test represents the composite achievement of an individual pupil in respect to the following subjects: reading, arithmetic, nature study and science, history and literature, language usage, and spelling. Results from tests of the separate subjects are summarized in the form of a composite representing the educational status of a pupil in reference to his achievement in mastering the curriculum considered as a whole.

The superiority of the educational age as a basis for sectioning in order to secure homogeneity in reading and arithmetic was again proven. Sections of less range and dispersion were secured by the application of the educational age as a basis of sectioning the total fifth-grade group than by the use of any of the other measures. A comparison of the results shown in Tables XIII and XXIV indicate that there is a gain secured by first reducing the membership of the fifth-grade group by applying the educational age as a basis of grade placement and then differentiating into ability sections on the same basis. This

¹ Stanford Achievement Test Manual, p. 16. World Book Company, Yonkers-on-the-Hudson, N. Y.

plan of classification reduces the range in reading from 72 months in 1924 and 1925 for the total group to 42 and 60 months for the group classified in the fifth grade on the basis of educational age. The standard deviations in reading were reduced from 12.6 and 14.7 months to 8.9 and 11.6 months for 1924 and 1925. The ranges in the individual X, Y, and Z sections were reduced in 1924 from 44, 44, and 40 months to 27, 39, and 27 months; and in 1925 from 56, 64, and 48 months to 48, 60, and 42 months. The standard deviations of the reading sections were reduced from 8.4, 8.8, and 7.0 months to 6.3, 7.1 and 8.0 months in 1924; and for the close of the year from 10.9, 11.1, and 9.2 months to 9.2, 10.0, and 9.0 months. In arithmetic the reductions were not nearly as great; the total ranges were reduced from 68 and 90 months to 63 and 89 months; and the standard deviations of the total groups from 11.4 and 17.1 months to 9.8 and 15.4 months. The ranges and the standard deviations of the separate X, Y, and Z sections showed no general tendency toward reduction.

TABLE XIII

THE RESULTS OF SECTIONING THE TOTAL GROUP INTO X, Y, AND Z SECTIONS ON THE BASIS OF THE EDUCATIONAL AGE

READING								
	R. A. '24	R. A. '25	Z '24	Z '25	Y '24	Y '25	X '24	X '25
Range....	9:0-15:0	10:0-16:0	9:0-12:4	10:0-14:0	10:0-13:8	10:0-15:4	11:4-15:0	11:4-16:0
Range in Months.	72	72	40	48	44	64	44	56
Average..	11:7.6	12:8.0	10:6.3	11:4.6	11:7.6	12:7.6	12:10.5	14:0.3
S. D.	12.6	14.7	7.0	9.2	8.8	11.1	8.4	10.9
Gain	12.4		10.8		12.0		13.8	
ARITHMETIC								
	A. A. '24	A. A. '25	Z '24	Z '25	Y '24	Y '25	X '24	X '25
Range....	9:8-15:4	10:2-17:8	9:8-12:4	10:2-14:9	9:8-14:0	10:2-17:3	10:4-15:0	11:5-17:8
Range in Months.	68	90	32	55	52	85	56	75
Average..	12:1.0	13:8.3	11:2.8	12:8.7	12:0.8	13:7.1	12:11.8	14:10.8
S. D.	11.4	17.1	8.0	13.2	9.8	14.7	10.3	16.6
Gain	19.3		17.9		18.3		23.0	

An attempt was made to evaluate the use of the educational age of the Stanford Achievement Test as a basis of classification by using much the same procedure that was used in the

TABLE XIV

THE RESULTS OF SECTIONING THE TOTAL GROUP INTO X, Y, AND Z SECTIONS ON THE BASIS OF THE EDUCATIONAL QUOTIENT

READING								
	R. A. '24	R. A. '25	Z '24	Z '25	Y '24	Y '25	X '24	X '25
Range....	9:0-15:0	10:0-16:0	9:0-12:4	10:0-15:0	9:0-13:8	10:0-16:0	10:8-15:0	11:4-16:0
Range in Months	72	72	40	60	56	72	52	56
Average..	11:7.6	12:8.0	10:9.4	11:9.0	11:7.3	12:7.4	12:8.1	13:9.4
S. D.	12.6	14.7	8.5	11.4	10.0	12.7	10.3	12.6
Gain	12.4		11.6		12.1		13.3	

ARITHMETIC								
	A. A. '24	A. A. '25	Z '24	Z '25	Y '24	Y '25	X '24	X '25
Range....	9:8-15:4	10:2-17:8	9:8-15:4	10:2-16:5	9:8-14:4	10:2-17:3	10:0-15:0	11:0-17:8
Range in Months	68	90	68	75	56	85	60	80
Average..	12:1.0	13:8.3	11:7.6	13:0.0	12:0.2	13:6.8	12:10.0	14:9.0
S. D.	11.4	17.1	13.0	15.0	10.2	14.6	12.2	18.3
Gain	19.3		16.4		18.6		23.0	

TABLE XV

EXTENT OF OVERLAPPING OF THE TOTAL GROUP CLASSIFIED INTO X, Y, AND Z SECTIONS ON THE EDUCATIONAL-AGE AND EDUCATIONAL-QUOTIENT BASES

SECTION		READING								ARITHMETIC							
		E. A.				E. Q.				E. A.				E. Q.			
		'24		'25		'24		'25		'24		'25		'24		'25	
		N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Z....	+y	9	11	14	16	6	7	15	18	17	20	17	20	20	24	23	27
	+x	0	0	2	2	0	0	3	3	5	6	2	2	8	9	5	6
Y....	-z	38	15	45	18	47	19	65	25	54	21	71	28	55	22	74	29
	+x	38	15	29	11	30	12	27	10	43	17	35	14	39	15	33	13
X....	-y	11	13	10	12	11	13	5	6	20	24	16	19	22	26	16	19
	-z	1	1	2	2	0	0	2	2	5	6	5	6	7	8	10	12
Total Overlapping.		23		23		22		24		32		33		32		34	

preceding study with the mental age. All pupils within the same span of eighteen months (11 years 0 months to 12 years 6 months) were considered as a group. This contained 276 pupils having an average educational age of 11 years 8.7 months and a standard deviation of 4.4 months.

A study of the other measures for pupils within this group indicates a wide variation in terms of ability and achievement

TABLE XVI

COMPARISONS OF EDUCATIONAL-AGE GROUP WITH OTHER MEASURES

	E. A.	M. A.	C. A.	R. A.	A. A.	I. Q.	E. Q.
Range	11:0-12:6	8:11-14:10	9:1-15:9	10:0-13:6	10:0-15:3	65-145	73-138
Range in Months	18	71	80	42	63	90	65
Average	11:8.7	11:4.7	11:6.4	11:11.4	12:1.8	100.8	103.6
S. D.	4.4	11.0	13.7	8.9	9.8	11.9	11.9

as measured by the other tests. In mental age there is a range of 71 months—from 8 years 11 months to 14 years 10 months—or from pupils of normal mental age for the third grade to pupils of normal mental age for the eighth grade. The average mental age is slightly below the average educational age—11 years and 4.7 months—and the wide variation is shown by a standard deviation of 11 months. In terms of intellectual ability as measured by the intelligence quotient there is an I. Q. range from 65 to 145, the average being 100.8 with a standard deviation of 11.9. Measured in terms of educational ability, there is a variation from dull to brilliant—from an E. Q. of 73 to one of 138. Within this 18 months' educational-age group, there is a range of 80 months in chronological age—from 9 years 1 month to 15 years 9 months, the average being 11 years 6.4 months with a standard deviation of 13.7 months. Taking reading and arithmetic individually there are present wide ranges in achievement. In reading there is a range of 42 months—10 years 0 months to 13 years 6 months. In arithmetic there is a much wider range of 63 months—10 years 0 months to 15 years 3 months.

Comparing these ranges and standard deviations with those for the total group, there have been only slight reductions by reducing the range to eighteen months in educational age. Mental age was reduced from 87 to 71 months in range and from 12.0 to 11.0 months in standard deviation. Chronological age was reduced in range from 88 to 81 months and from 15.3 to 14.0 months in the standard deviations. In reading the range was reduced from 72 to 42 months, with a decrease in the standard deviation of 3 months—from 11.9 to 8.9. The range and dispersion of arithmetic were only slightly decreased—from 66 to 63 months in range and 10.2 to 9.8 months in dispersion.

This lack of homogeneity in the other measures is clearly

TABLE

EDUCATIONAL-AGE GROUP CLASSIFIED IN MONTHS

E. A. '24		M. A. '24				C. A. '24				R. A. '24			
Month	N	Range	Mo.	Med.	Q.	Range	Mo.	Med.	Q.	Range	Mo.	Med.	Q.
11:1...	18	8:11-13:0	49	10:9	5.5	10: 6-13:10	40	12:0	10.0	10: 1-12:1	24	11:2	6.0
11:2...	18	9: 0-12:6	42	11:0	7.0	9: 4-15:9	77	11:11	11.5	10: 2-12:5	27	10:11	2.0
11:3...	25	9: 1-12:4	39	11:0	8.5	10: 2-15:1	59	11:5	12.5	10: 3-11:9	18	11:3	3.5
11:4...	15	10: 1-11:10	21	10:8	7.5	10: 6-15:7	61	11:6	13.5	10: 1-12:8	31	11:2	5.5
11:5...	25	9: 1-12:2	37	11:1	6.0	10: 4-14:2	46	11:6	10.0	10:10-13:0	26	11:5	3.5
11:6...	23	10: 0-13:1	37	11:0	8.5	9:11-15:4	65	11:2	11.0	10: 5-12:9	28	11:6	5.0
11:7...	22	9: 8-12:6	34	11:3	4.5	10: 3-15:7	64	11:3	8.0	11: 0-12:8	20	11:5	4.0
11:8...	17	8:11-11:11	36	11:5	4.5	9:10-13:9	47	11:0	13.0	10: 3-12:7	28	11:9	6.0
11:10...	26	10: 7-13:1	30	11:6	5.5	9: 9-13:2	41	10:9	8.5	11: 2-13:0	22	12:0	5.0
11:11...	21	10: 1-12:10	33	11:5	9.0	10: 3-13:9	42	11:3	6.0	11: 0-13:4	26	12:4	5.0
12:0...	20	10: 0-13:1	37	12:0	8.5	9: 6-15:4	70	10:9	9.5	10:11-13:8	33	12:3	4.5
12:1...	15	9:11-14:0	49	12:0	5.0	9: 9-13:3	42	11:0	7.5	11: 8-13:6	22	12:6	5.0
12:2...	11	10:11-13:10	35	11:11	9.0	10: 0-13:11	47	10:11	7.0	11: 7-13:3	20	12:4	4.5
12:4...	20	10: 8-14:10	50	12:4	8.5	8:10-11:11	37	10:8	6.5	11: 4-13:8	28	12:8	5.0
12:6...	9	11: 9-15:7	46	12:3	11.0	9: 1-12:0	35	10:11	8.5	11:10-13:9	23	12:9	7.0

shown in Table XVII in which the educational-age group is classified in intervals of the same educational-age month. Selecting the 23 pupils of the same educational-age month, 11 years 6 months, as an illustration, it is seen that they are scattered over a chronological-age range of 65 months with a quartile deviation of 11 months. This group showed a range of 37 months in mental age with the same deviation of 11 months. In both reading and arithmetic, pupils of the same educational-age month were scattered over ranges of 28 and 35 months, respectively.

Further study was made into the homogeneity of this educational-age group in respect to reading and arithmetic by studying these subject ages for the pupils included within the same educational-age month. The differences between the subject ages and the educational-age month of the pupil were computed and tabulated as plus or minus differences. For example, in Table XVIII, pupils possessing the same educational-age month of 11 years 1 month ranged in reading age from 10 years 1 month to 12 years 1 month or were scattered over a range of minus 12 months to plus 12 months, the educational-age month being considered as the point of reference. In arithmetic, the pupils showed a range from minus 14 to plus 25 months with an average difference of 9.3 months from the educational-age month of 11 years 1 month.

XVII

AND COMPARISON WITH OTHER MEASUREMENTS

A. A. '24				E. Q. '24				I. Q. '24			
Range	Mo.	Med.	Q.	Range	Mo.	Med.	Q.	Range	Mo.	Med.	Q.
9:11-13:2	39	11:6	5.0	79-112	33	92	8.0	65-111	46	90	7.5
11: 2-13:2	24	11:8	5.5	77-119	42	92	8.5	69-109	40	90	9.5
10: 4-13:9	41	11:8	5.0	75-112	37	99	9.0	69-115	46	92	7.5
9:11-13:9	46	12:0	5.5	73-108	35	99	9.0	70-105	35	94	7.5
10: 4-13:2	34	11:11	6.5	80-111	31	101	9.0	67-117	50	100	6.5
10: 6-13:5	35	11:9	5.5	86-117	31	105	8.5	76-127	51	99	7.0
10:10-14:0	38	12:2	5.5	78-112	39	101	7.0	71-112	41	98	6.0
11: 6-15:4	46	12:4	4.5	84-118	34	106	8.5	73-118	45	95	11.5
10: 3-13:5	38	12:2	4.0	89-121	32	111	5.0	82-130	48	106	6.0
10:10-13:9	35	12:5	5.0	87-119	27	108	5.0	87-119	32	98	5.0
10: 8-13:9	37	12:0	6.5	78-126	48	109	6.0	81-126	45	107	8.0
11: 6-14:6	36	12:5	7.0	91-125	34	111	7.5	87-127	40	113	6.5
11:11-13:2	15	12:5	5.0	88-123	35	111	7.5	83-136	53	109	4.0
10: 4-14:6	38	12:7	7.0	103-138	35	116	5.5	92-136	44	117	6.0
11: 4-14:6	26	12:7	8.5	103-136	33	116	8.5	98-145	47	123	9.5

Summarizing this study, it is seen that in reading there is an average range of 25.7 months within these various month groups with an average difference of 5.7 months from the respective educational-age month. For arithmetic, this range is over three years, being 37.2 months, with an average difference from the educational-age month of 8.5 months.

A comparison was then made of the differences existing between the reading and arithmetic ages of the pupils making up these month groups. These differences were computed and the ranges and averages tabulated in Table XVIII. In the 11 years 1 month group the pupils possessed differences in their reading and arithmetic ages of from 0 to 26 months, with an average difference of 9.3 months. It is seen from the results which are summarized in the table that there is an average difference between the pupils' reading and arithmetic ages of 11.5 months, that is, there is nearly a year's difference between the reading age and arithmetic age of the average pupil; 50 per cent of the pupils possess a smaller difference than 11.5 months; and 50 per cent, a greater difference—the range of differences being from 0 to 61 months in their reading and arithmetic ages.

This would indicate that if the educational age of the Stanford Achievement Test is to be used as a basis of classification in grade placement, then some provision must be made that will take care of the subject differences which exist within the indi-

TABLE XVIII

EDUCATIONAL-AGE GROUP CLASSIFIED INTO MONTH DIVISIONS. COMPARISONS MADE OF THE READING AND ARITHMETIC AGES OF THE INDIVIDUAL PUPILS WITHIN THE MONTH DIVISIONS, BETWEEN THEIR RESPECTIVE READING AGE, ARITHMETIC AGE AND EDUCATIONAL AGE AND ALSO BETWEEN READING AGE AND ARITHMETIC AGE

		R. A. '24		A. A. '24		DIFFERENCE IN MONTHS BETWEEN R. A. AND A. A.	
E. A. '24	N	Range in Months	Average D	Range in Months	Average D	Range in Months	Average Difference
11:1....	18	-12 to +12=24	6.0	-14 to +25=39	8.5	0 to 26=26	9.3
11:2....	18	-14 to +15=29	5.3	0 to +24=24	9.8	3 to 37=34	15.2
11:3....	25	-12 to + 6=18	2.9	-11 to +30=41	8.0	0 to 40=40	10.2
11:4....	15	-15 to +16=31	5.0	-17 to +29=46	11.2	1 to 44=43	15.2
11:5....	25	- 7 to +19=26	4.3	-13 to +21=34	9.3	1 to 30=29	10.5
11:6....	23	-13 to +15=28	6.0	-12 to +23=35	7.9	0 to 34=34	11.0
11:7....	22	- 7 to +13=20	4.3	- 9 to +29=38	10.5	2 to 34=32	14.0
11:8....	17	-17 to +11=28	6.0	- 2 to +44=46	7.9	0 to 61=61	10.0
11:10....	26	- 8 to +12=20	5.6	-19 to +19=38	7.5	0 to 24=24	10.7
11:11....	21	-11 to +15=26	6.9	-13 to +22=35	7.5	1 to 33=32	10.7
12:0....	20	-13 to +20=33	6.4	-16 to +21=37	6.6	0 to 26=26	11.4
12:1....	15	- 5 to +17=22	6.8	- 7 to +29=36	9.5	0 to 34=34	13.0
12:2....	11	- 7 to +13=20	5.8	- 3 to +12=15	6.4	2 to 17=15	9.8
12:4....	19	-12 to +16=28	6.8	-24 to +26=50	8.1	2 to 40=38	10.2
Total	274	Average 25.7	5.7	37.2	8.5		11.5

Range = Range of student's subject ages with E. A. month: - 12 to + 12 for an E. A. of 11:1 means an R. A. range from 10 years 1 month to 12 years 1 month.

Mos. = Total range in months.

Ave. D. = Average deviation from E. A. month.

Ave. diff. = Average differences between the R. A. and A. A. of the individual students.

vidual pupils. Dividing the class into X, Y, and Z sections may adequately meet the problem arising from individual differences between pupils, but it does not solve the problem of subject differences within the pupils. These pupils must be thought of as being non-homogeneous in respect to reading and arithmetic and must be considered as individuals and not simply as members of some homogeneous section that has been classified on some broader basis.

Consideration was then given to the proposed plans of classifying pupils into X, Y, and Z sections upon the following bases: intelligence quotient, educational quotient, "brightness average,"

TABLE XIX

RESULTS OF CLASSIFYING THIS EDUCATIONAL-AGE GROUP INTO X, Y, AND Z SECTIONS ON THE BASIS OF THE I.Q. FOR 1924 AND 1925

READING								
	R. A. '24	R. A. '25	Z '24	Z '25	Y '24	Y '25	X '24	X '25
Range....	10:0-13:6	10:3-15:3	10:0-12:9	10:3-15:0	10:0-13:6	11:0-15:3	11:0-13:6	11:9-14:9
Range in Months..	42	60	33	57	42	51	30	36
Average...	11:9.7	12:10.1	11:4.9	12:3.6	11:9.5	12:10.0	12:4.2	13:5.6
S. D.	8.9	11.6	9.1	10.2	9.5	10.7	7.1	9.1
Gain	12.4		10.7		12.5		13.4	

ARITHMETIC								
	A. A. '24	A. A. '25	Z '24	Z '25	Y '24	Y '25	X '24	X '25
Range....	10:0-15:3	10:3-17:8	10:0-13:9	10:9-16:4	10:0-14:0	11:0-17:8	10:3-14:6	11:4-17:4
Range in Months..	63	89	45	76	48	80	51	72
Average...	12:1.2	13:9.1	11:10.8	13:3.3	12:2.0	13:9.2	12:4.0	14:4.0
S. D.	9.8	15.4	11.2	15.6	8.4	13.4	9.2	17.8
Gain	19.2		16.5		19.2		24.0	

TABLE XX

RESULTS OF CLASSIFYING THIS EDUCATIONAL-AGE GROUP INTO X, Y, AND Z SECTIONS ON THE BASIS OF THE E.Q. FOR 1924 AND 1925

READING								
	R. A. '24	R. A. '25	Z '24	Z '25	Y '24	Y '25	X '24	X '25
Range....	10:0-13:6	10:3-15:3	10:0-12:9	10:3-15:0	10:0-13:6	10:3-15:3	10:9-13:6	11:9-14:9
Range in Months..	42	60	33	57	42	60	33	36
Average...	11:9.7	12:10.1	11:4.1	12:4.0	11:9.3	12:9.9	12:4.1	13:5.2
S. D.	8.9	11.6	7.5	11.5	8.5	11.0	7.7	9.5
Gain	12.4		11.9		12.6		13.1	

ARITHMETIC								
	A. A. '24	A. A. '25	Z '24	Z '25	Y '24	Y '25	X '24	X '25
Range....	10:0-15:3	10:3-17:8	10:3-13:9	10:3-16:4	10:9-14:6	11:0-17:0	10:3-14:3	11:4-17:8
Range in Months..	63	89	42	73	45	72	48	76
Average...	12:1.9	13:9.1	11:11.1	13:3.8	12:2.0	13:9.4	12:3.8	14:1.7
S. D.	9.8	15.4	11.2	16.9	8.6	13.4	9.2	17.7
Gain	19.2		16.7		19.4		22.9	

TABLE XXI

RESULTS OF CLASSIFYING THIS EDUCATIONAL-AGE GROUP INTO X, Y, AND Z
SECTIONS ON THE BASIS OF THE "BRIGHTNESS AVERAGE" FOR
1924 AND 1925

READING								
	R. A. '24	R. A. '25	Z '24	Z '25	Y '24	Y '25	X '24	X '25
Range....	10:0-13:6	10:3-15:3	10:0-12:9	10:3-15:0	10:0-13:6	10:3-15:3	11:0-13:6	11:9-14:9
Range in Months..	42	60	33	57	42	60	30	36
Average..	11:9.7	12:10.1	11:4.7	12:4.0	11:9.0	12:9.6	12:4.5	13:5.9
S. D.	8.9	11.6	7.9	11.0	8.4	10.7	7.5	9.6
Gain	12.4		11.8		12.6		13.4	

ARITHMETIC								
	A. A. '24	A. A. '25	Z '24	Z '25	Y '24	Y '25	X '24	X '25
Range....	10:0-15:3	10:3-17:8	10:0-13:9	10:0-16:4	10:0-14:6	11:0-17:8	10:0-14:6	11:4-17:4
Range in Months..	63	89	45	76	54	80	54	72
Average..	12:1.9	13:9.1	11:10.9	13:4.8	12:1.9	13:8.6	12:3.2	14:2.4
S. D.	9.8	15.4	13.1	16.6	7.9	13.4	9.1	17.4
Gain	19.2		17.4		18.7		23.2	

TABLE XXII

RESULTS OF CLASSIFYING THIS EDUCATIONAL-AGE GROUP INTO X, Y, AND Z
SECTIONS ON THE BASIS OF THE ACCOMPLISHMENT QUOTIENT
FOR 1924 AND 1925

READING								
	R. A. '24	R. A. '25	Z '24	Z '25	Y '24	Y '25	X '24	X '25
Range....	10:0-13:6	10:3-15:3	10:0-13:3	11:0-14:9	10:0-13:6	10:9-15:0	10:0-13:6	10:3-15:3
Range in Months..	42	60	39	45	42	51	42	60
Average..	11:9.7	12:10.1	12:0.1	13:0.9	11:9.9	12:10.1	11:8.3	12:7.5
S. D.	8.9	11.6	9.5	11.0	8.8	10.4	9.0	12.6
Gain	12.4		12.8		12.2		11.2	

ARITHMETIC								
	A. A. '24	A. A. '25	Z '24	Z '25	Y '24	Y '25	X '24	X '25
Range....	10:0-15:3	10:3-17:8	10:4-14:4	10:4-16:8	10:4-15:4	11:0-17:4	10:4-14:4	10:4-15:4
Range in Months..	63	89	48	76	60	76	48	60
Average..	12:1.9	13:9.1	12:2.4	13:10.0	12:2.2	13:9.8	12:2.0	13:4.6
S. D.	9.8	15.4	10.5	16.5	9.6	16.4	8.9	11.7
Gain	19.2		19.6		19.6		14.6	

TABLE XXIII

RESULTS OF CLASSIFYING THIS EDUCATIONAL-AGE GROUP INTO X, Y, AND Z SECTIONS ON THE BASIS OF THE MENTAL AGE FOR 1924 AND 1925

READING								
	R. A. '24	R. A. '25	Z '24	Z '25	Y '24	Y '25	X '24	X '25
Range....	10:0-13:6	10:3-15:3	10:0-12:9	10:3-14:0	10:0-13:6	10:9-15:3	10:6-13:6	11:3-14:9
Range in Months..	42	60	33	45				
Average..	11:9.7	12:10.1	11:4.5	12:3.4	11:9.6	12:10.3	12:3.3	13:4.5
S. D.	8.9	11.6	6.3	9.9	7.6	11.0	9.1	10.6
Gain	12.4		10.9		12.7		13.2	

ARITHMETIC								
	A. A. '24	A. A. '25	Z '24	Z '25	Y '24	Y '25	X '24	X '25
Range....	10:0-15:3	10:3-17:8	10:0-13:8	10:0-16:4	10:0-15:4	11:0-17:8	10:4-14:4	11:4-17:4
Range in Months..	63	89	44	76	64	80	48	72
Average..	12:1.9	13:9.1	11:11.2	13:1.6	12:1.7	13:9.2	12:4.4	14:4.4
S. D.	9.8	15.4	9.2	12.8	9.6	14.2	10.3	16.2
Gain	19.2		14.4		19.5		24.0	

TABLE XXIV

RESULTS OF CLASSIFYING THIS EDUCATIONAL-AGE GROUP INTO X, Y, AND Z SECTIONS ON THE BASIS OF EDUCATIONAL AGE FOR 1924 AND 1925

READING								
	R. A. '24	R. A. '25	Z '24	Z '25	Y '24	Y '25	X '24	X '25
Range....	10:0-13:6	10:3-15:3	10:0-12:3	10:3-13:9	10:0-13:3	10:3-15:3	11:3-13:6	11:3-15:3
Range in Months..	42	60	27	42	39	60	27	48
Average..	11:9.7	12:10.1	11:1.5	12:1.9	11:9.1	12:9.4	12:7.5	13:8.4
S. D.	8.9	11.6	8.0	9.0	7.1	10.0	6.3	9.2
Gain	12.4		12.4		12.3		12.9	

ARITHMETIC								
	A. A. '24	A. A. '25	Z '24	Z '25	Y '24	Y '25	X '24	X '25
Range....	10:0-15:3	10:3-17:8	10:0-13:4	10:0-15:0	10:0-14:0	11:0-17:0	10:4-14:4	11:4-17:8
Range in Months..	63	89	40	60	48	72	48	76
Average..	12:1.9	13:9.1	11:8.4	13:0.4	12:2.8	13:9.2	12:6.0	14:6.0
S. D.	9.8	15.4	8.8	13.2	9.4	13.7	9.5	17.1
Gain	19.2		16.0		18.4		24.0	

accomplishment quotient, mental age, and educational age. The same procedure for grouping, which was used in evaluating mental age, was applied to this educational-age group.

Tables XIX to XXV present the results of these various plans of classification. The range of the reading and arithmetic ages of this total educational-age group was increased from 42 to 60 months for reading, and from 63 to 89 months for arithmetic. The dispersion was increased from 8.9 months to 11.6 months in reading, and from 9.8 months to 15.4 months in arithmetic. The percentage of overlapping between the sections when they are classified on these various bases is shown in Tables XXV and XXVI.

When these various tables are compared as to ranges, dispersion, and total percentage of overlapping they show educational age to be the best basis for dividing this educational-age group into homogeneous sections in terms of ability and achievement in both reading and arithmetic. This measure as a basis of classification produces X, Y, and Z sections having ranges in reading of 27, 39, and 27 months in 1924, and 48, 60, and 42 months in 1925. The dispersions of these sections are standard deviations of 6.3, 7.1, and 8.0 months and 9.2, 10.0, and 9.0 months. In arithmetic the sections having ranges of 48, 48, and 40 months in 1924, and 76, 72, and 60 months in 1925, with standard deviations of 9.5, 9.4, and 8.8, and 17.1, 13.7, and 13.2 months for the X, Y, and Z sections, respectively. It is to be noticed that in each subject the Y section did not gain quite as much as the Z section. In the total percentage of overlapping the educational age is clearly superior to the other bases. With educational age as a basis, it is seen that there is present an overlapping of 25 and 26 per cent in reading and of 41 and 43 per cent in arithmetic. The intelligence quotient was the next best basis, with a percentage of 46 and 42 in reading and 59 and 50 in arithmetic.

SUMMARY

Educational age as a basis of classification for grade placement results in grouping together pupils who are scattered over a wide range of ability and achievement when measured by the other tests. Pupils ranging in normal mental age for the third grade to those of normal mental age for the eighth grade were included within the same group. In chronological age there was much the same range. In reading and arithmetic, there was present for each wide ranges of achievement—in reading a

TABLE XXV
EXTENT OF OVERLAPPING OF THE EDUCATIONAL-AGE GROUP CLASSIFIED INTO X, Y, AND Z SECTIONS ON THE INTELLIGENCE-QUOTIENT, EDUCATIONAL-QUOTIENT, AND "BRIGHTNESS-AVERAGE" BASES

SECTION	READING												ARITHMETIC											
	I. Q.						E. Q.						I. Q.						E. Q.					
	'24			'25			'24			'25			'24			'25			'24			'25		
	N	%		N	%		N	%		N	%		N	%		N	%		N	%		N	%	
Z.....	16	30	16	30	13	24	16	29	17	30	17	30	20	36	25	45	20	36	22	40	22	40	22	40
+x	5	9	7	13	5	9	9	20	7	8	14	16	29	11	20	18	33	17	31	19	33	16	29	
-z	59	36	49	29	47	28	53	32	57	34	55	33	58	36	55	33	62	38	51	30	66	40	59	35
+x	39	24	40	25	40	24	40	24	34	21	42	25	59	36	42	26	57	35	57	35	67	40	52	31
-y	11	20	10	18	12	22	12	22	10	18	10	18	23	42	19	35	24	44	24	44	26	47	21	39
X.....	5	9	3	5	4	8	5	9	3	5	4	7	15	28	12	22	16	29	13	24	18	32	15	27
Total	125	46	115	42	112	41	121	44	117	43	124	45	160	59	136	50	168	61	154	57	181	66	154	56
Overlapping																								

I. Q. = Intelligence quotient.

E. Q. = Educational quotient.

B. A. = "Brightness average," representing average of I. Q. and E. Q.

+ y = Above the average of the Y section.

+ x = Above the average of the X section.

- y = Below the average of the Y section.

- z = Below the average of the Z section.

range of 42 months with a standard deviation of 8.9 months and in arithmetic a range of 63 months with a standard deviation of 9.8 months. These represent only slight reductions when compared with those of the total fifth-grade classes.

A comparison of the differences between the reading and arithmetic ages of pupils of the same educational-age month shows that there is an average difference of nearly a year. The differences range from 0 months to 61 months. This would indicate that if the educational age of the Stanford Achievement Test is to be used as a basis of classification in grade placement, some provision must be made that will take care of these subject differences existing within the individual pupils. Grouping pupils into X, Y, and Z sections may adequately meet the problem arising from individual differences between pupils, but it does not necessarily solve the problem of subject differences within the pupils. These pupils must be thought of as non-homogeneous in respect to reading and arithmetic, and considered as individuals and not simply as members of some homogeneous section that has been classified on some broader basis.

An evaluation of the bases of sectioning also shows educational age to be the best basis for dividing this educational-age group into sections, in terms of ability and achievement in reading and arithmetic. The intelligence quotient was found to be the next best basis for sectioning.

CHAPTER V

ARITHMETIC AGE AS A BASIS OF CLASSIFICATION

This investigation has shown that it is impossible to secure homogeneity in terms of equal educational status, or equal ability to progress, in an individual subject such as arithmetic by using either the mental age of the National Intelligence Test or the Educational Age of the Stanford Achievement Test as bases of classification. The mental age as a basis of classification included within the same group pupils ranging in arithmetic achievement over a range of 51 months, with a standard deviation of 10.1 months. This range was increased to 80 months and the standard deviation to 15.8 months during the next year's work. With the mental age as a basis of classification there was a range of 63 months in arithmetic in 1924, which was increased to 89 months, the standard deviation was increased from 9.8 months to 15.4 months during the year. The best basis for sectioning that was found by this study was the combination of the mental age as a basis of grade placement with the educational age as a basis of sectioning, resulting in sections with ranges averaging over three years in 1924 and more than five years at the end of the year's work.

The important administrative problem is then raised—Is it possible to so departmentalize the system of classification that pupils who are homogeneous in terms of subject ability may be grouped into classes for purposes of instruction in that particular subject?

TABLE XXVII
COMPARISONS OF ARITHMETIC-AGE GROUP WITH THE OTHER MEASURES
N 261

	E. A. '24	C. A. '24	M. A. '24	R. A. '24	Marks '24	I. Q. '24	A. Q. '24	Acc. Q. '24
Range....	10:0-18:3	8:1-15:7	8:0-13:8	9:0-14:4	58-94	60-150	70-145	82-150
Range in Months.	39	90	68	64	36	90	75	68
Average...	11:5.6	11:5.2	11:1.1	11:6.9	77.5	96.5	105.4	108.4
S. D.	7.2	13.7	12.7	12.0	7.2	15.5	11.2	11.0

A. Q. '24 = Arithmetic Quotient.

Acc. Q. = Accomplishment Quotient in Arithmetic.

A study was therefore made to determine whether or not it is possible to secure within an individual subject, such as arithmetic, that degree of homogeneity that is considered necessary for the efficient teaching of pupils as a section.

An arithmetic-age group of the same range as that found in the other studies of the mental and educational ages (11 years 0 months to 12 years 6 months) was selected for purposes of investigation. This gave a group of 261 pupils with an average arithmetic age of 11 years 9.8 months and a standard deviation of 4.7 months.

Table XXVII represents the comparisons of this arithmetic-age group with the other measures. In chronological age there is present within this eighteen months' arithmetic-age group a range of 90 months in chronological age—from 8 years 1 month to 15 years 7 months. The mental ages of this group were scattered over a range of 68 months—from 8 years 0 months to 13 years 8 months, with an average mental age of 11 years 1 month and a standard deviation of 12.7 months. The arithmetical ability of the group is measured by the arithmetic quotient, varied from 70 to 145 with an average of 105.4 and a standard deviation of 11. The acceleration in arithmetic of these fifth-grade pupils is indicated by an average accomplishment quotient in arithmetic of 108.4.

This extreme lack of homogeneity in terms of the other measures indicates that homogeneity can only be secured in the measure that is being used as a basis of classification. This would be sufficient providing the group either possessed the ability to progress as a group, or could be classified into sections possessing that homogeneity of ability requisite to progress as a section.

In considering the use of the arithmetic age of the Stanford Achievement Test as a basis of classification, it is necessary to recognize that this measure represents a composite of achievement in the separate processes of computation and reasoning. These two processes are only slightly related, the correlation between them for the group under consideration being 0.29. Combining scores from tests in computation and reasoning into an arithmetic age does not give an accurate presentation of an individual achievement in respect to these two separate processes. Pupils possessing the same arithmetic age may vary

widely in respect to their achievement in computation and reasoning.

A study of the composition of the arithmetic age as shown in Table XXVIII reveals this to be the case. The arithmetic-age group which was considered above was classified in terms of months as shown in the table. Comparison of scores in computation and reasoning were made of the various pupils making up these monthly groups. Table XXVIII shows that pupils having the same arithmetic age in months vary widely in achievement in the separate processes of computation and reasoning. There was an average range for these month groups of 26.5 points in computation and 25.8 points in scores of reasoning. This means that in the arithmetic-age month, 11 years 6 months, there were pupils having achievement in computation ranging from the average in computation of pupils of 9 years 8 months to pupils possessing an arithmetic age of 11 years 6 months. The range for the reasoning scores was from 10 years 6 months to 12 years 5 months. Attacking it from a slightly different angle, it may be considered that among the same pupils there may be a range of over two years in achievement in these separate processes of computation and reasoning.

Computation of arithmetic age also presents a problem in securing an accurate basis for evaluating the work of the past year, for gain in months in arithmetic age of the Stanford Achievement Test during the year's work does not necessarily mean that the pupils have made equal gains in achievement in the separate processes of computation and reasoning. This fact is shown in a study of 155 pupils of the arithmetic-age group under consideration who made gains in arithmetic age of from 8 to 19 months, inclusive, during the year 1923-1924. These pupils were classified in terms of the number of months' gain, as shown in Table XXIX, and comparisons of the gains in computation and reasoning were made within these month groups. The scores for computation and reasoning show an average range in the gain for these month groups of approximately 35 points. Considering the pupils who had made equal gains of 12 months each in arithmetic age, it is seen that in gain in computation and reasoning they were scattered over ranges of 36 points, ranging from a gain of minus 4 to a gain of plus 32, that is, one pupil who had gained 12 months in arithmetic had lost 4

TABLE XXVIII

VARIATIONS OF COMPUTATION AND REASONING SCORES OF PUPILS INCLUDED WITHIN THE ARITHMETIC-AGE MONTH DIVISIONS

MONTH DIVISION	N	COMPUTATION				REASONING			
		Limits	Range	Med.	Q.	Limits	Range	Med.	Q.
11:0.....	9	76-100	24	88	6	24-48	24	36	6
11:2.....	15	72-92	20	80	4	36-56	20	48	6
11:4.....	18	68-96	28	84	6	36-64	28	48	6
11:6.....	32	60-96	36	80	6	40-68	28	56	6
11:8.....	31	68-100	32	88	6	40-72	32	52	6
11:9.....	27	80-108	28	88	6	36-64	28	56	6
11:11.....	30	84-104	20	92	2	44-64	20	56	2
12:0.....	22	88-108	20	96	6	44-64	20	56	6
12:2.....	28	84-116	32	96	4	40-72	32	60	6
12:4.....	22	88-112	24	96	6	48-72	24	60	6
12:5.....	27	84-112	28	100	4	52-80	28	60	4
Total ...	261	Average Range	26.5			Average Range	25.8		

Med. = Median.

Q. = Semi-interquartile deviation.

TABLE XXIX

VARIATIONS IN COMPUTATION AND REASONING OF PUPILS MAKING EQUAL GAINS IN MONTHS IN ARITHMETIC AGE

GAIN IN MONTHS	N	COMPUTATION				REASONING			
		Limits	Range	Med.	Ave.	Limits	Range	Med.	Ave.
8.....	8	- 4 to +24	28	0	7.5	- 4 to +20	24	16	10.5
9.....	13	-12 to +36	48	8	9.8	-16 to +32	48	12	11.4
10.....	10	0 to +28	28	8	9.0	- 8 to +24	32	12	12.0
11.....	15	- 4 to +24	28	12	9.7	- 4 to +28	32	14	13.0
12.....	17	- 4 to +32	36	16	15.0	- 4 to +32	36	8	11.7
13.....	13	0 to +32	32	16	18.1	- 4 to +32	36	16	13.3
14.....	16	0 to +28	28	20	17.0	0 to +28	28	12	13.1
15.....	11	+ 4 to +28	24	20	17.8	+ 4 to +28	24	16	15.3
16.....	23	- 4 to +32	36	20	18.9	+ 4 to +40	36	16	16.7
17.....	11	+ 4 to +36	32	20	20.7	+ 4 to +32	28	16	17.1
18.....	18	+12 to +44	32	24	26.0	- 4 to +28	32	12	13.6
Total	155	Average Range	35.2			Average Range	35.6		

points in computation and gained 32 points in reasoning, and another pupil who had made the same gain of 12 months in arithmetic age, had gained 32 points in computation and lost 4 points

in reasoning. These two pupils were considered to have made equal gains of 12 months each in arithmetic age. Similar illustrations may be found in any of the month groups in the table. For the eighteen months' group the difference is even greater, being from minus 4 points gain in computation to plus 44 in reasoning, and from minus 4 in reasoning to plus 40 in computation.

The problem of segregating this arithmetic-age group into ability sections was attacked by dividing the group into X, Y, and Z sections, using the intelligence and arithmetic quotients

TABLE XXX
RESULTS OF CLASSIFYING THIS ARITHMETIC-AGE GROUP INTO X, Y, AND Z
SECTIONS ON THE BASIS OF THE INTELLIGENCE AND ARITHMETIC
QUOTIENTS

INTELLIGENCE QUOTIENT								
	A. A. '24	A. A. '25	Z '24	Z '25	Y '24	Y '25	X '24	X '25
Range....	11:0-12:6	10:10-16:8	11:0-12:6	11:2-15:6	11:0-12:6	10:10-16:2	11:2-12:6	11:10-16:8
Range in Months..	18	70	18	52	18	64	16	58
Average...	11:9.9	13:5.3	11:8.8	12:10.8	11:9.8	13:5.1	11:11.4	14:1.7
S. D.	4.7	13.6	4.2	11.6	4.9	11.6	4.2	14.7
Gain	19.4		14.0		19.3		26.3	

ARITHMETIC QUOTIENT								
	A. A. '24	A. A. '25	Z '24	Z '25	Y '24	Y '25	X '24	X '25
Range....	11:11-12:6	10:10-16:8	11:0-12:6	10:10-14:10	11:0-12:6	10:10-16:2	11:4-12:6	11:10-16:8
Range in Months..	18	70	18	48	18	64	14	58
Average...	11:9.9	13:5.3	11:6.3	13:0.2	11:9.6	13:5.4	12:3.5	13:10.0
S. D.	4.7	13.6	5.0	11.7	4.4	12.5	3.5	14.7
Gain	19.4		17.9		19.8		19.5	

as bases. The same procedure was followed that was used with the mental- and educational-age groups. The range for the total group in arithmetic was increased during the year from 18 months at the beginning to 70 months at the end, with a corresponding, large increase in the standard deviations—from 4.7 months to 13.6 months. The pupils in this arithmetic-age group made gains ranging from minus 8 months to plus 52 months; 42 of the group making gains of less than 6 months; and 59 making gains of more than 24 months.

Table XXX presents in summary form the results of applying

this plan of classification. The intelligence quotient does not divide this arithmetic-age group into sharply-defined sections, as indicated by the closeness of the averages of the sections which were 11 years 8.8 months, 11 years 9.8 months, and 11 years 11.4 months for the Z, Y, and X sections, respectively. The ranges of the sections were increased from 16, 18, and 18 months to 52, 64, and 58 months during the year studied. The arithmetic quotient differentiates the arithmetic-age group into more sharply-defined sections as indicated by the differences between the averages of the sections; being 12 years 3 months, 11 years 11.3 months, and 11 years 6.3 months for the X, Y, and Z sections, respectively. The ranges were increased from 14, 18, and 18 months to 58, 64, 48 months for these sections.

A study of the percentage of overlapping to be found between these sections when they are classified on the bases of the intelligence and arithmetic quotients shows very clearly the inadequacy of these measures as bases of sectioning this arithmetic-age group into sections that are homogeneous in terms of ability to progress at the same rate. With the intelligence quotient as

TABLE XXXI

ARITHMETIC-AGE GROUP OF 1924 DIVIDED INTO X, Y, AND Z SECTIONS ON BASIS OF INTELLIGENCE QUOTIENT AND ARITHMETIC QUOTIENT, SHOWING AMOUNT OF OVERLAPPING

SECTION		I. Q.				A. Q.			
		1924		1925		1924		1925	
		N	%	N	%	N	%	N	%
Z	+ y	18	35	15	29	11	21	20	38
	+ z	18	35	9	18	5	10	15	29
Y	- z	63	40	48	31	32	20	54	34
	+ x	72	46	37	24	23	15	60	38
X	- y	20	38	16	31	11	21	21	40
	- z	14	27	13	25	2	04	15	29
Total Overlapping ...		173	66	116	44	77	30	155	59

a basis of sectioning, there is present an overlapping of 66 per cent in 1924 and of 44 per cent at the close of the year. Using the arithmetic quotient as a basis resulted in an overlapping of 30 per cent at the beginning and of 59 per cent at the end of the year. In the following section it was discovered that the correlation between the intelligence quotient and the number of month's gain during the year was 0.287, while that for the arithmetic

quotient was only 0.13. This accounts for the failure of these measures to divide this arithmetic-age group into sections that will progress at the same rate.

An attempt was made to divide this arithmetic-age group into sections that would make approximately the same gain during the next year, by considering all of the measures of ability that have been used in this study. The following measures were applied: intelligence quotient, arithmetic quotient, accomplishment quotient in arithmetic, teachers' marks in arithmetic, and the number of month's gain during the year 1923-1924. The number of month's gain during the year 1924-1925 was used as the criterion in judging the relative effectiveness of these measures. Table XXXII shows the results of this plan. The intelligence quotient produces the best results with a percentage of overlapping of 46 per cent, with the accomplishment second with a percentage of 71 per cent.

TABLE XXXII

EXTENT OF OVERLAPPING BETWEEN THE X, Y, AND Z SECTIONS OF THE ARITHMETIC-AGE GROUP, CLASSIFIED ON THE BASIS OF THE INTELLIGENCE QUOTIENT, THE ARITHMETIC QUOTIENT, THE ACCOMPLISHMENT QUOTIENT, MARKS, AND GAIN

SECTION	I. Q.		A. Q.		Acc. Q.		Marks		Gain		A. A. '24	
	N	%	N	%	N	%	N	%	N	%	N	%
+y	16	31	21	40	14	27	20	38	16	31	30	58
+x	8	15	19	36	12	23	14	27	10	19	27	52
-z	49	51	59	38	41	26	62	39	65	42	87	55
+x	40	26	83	53	55	35	49	31	16	42	75	48
-z	14	27	22	42	10	19	11	21	17	33	22	42
-y	16	31	24	47	19	36	16	31	20	39	28	54
Total	121	47	187	71	129	49	151	56	174	64	220	84

I. Q. = Intelligence Quotient.

A. Q. = Arithmetic Quotient.

Acc. Q. = Accomplishment Quotient in Arithmetic.

Gain = Number of Month's Gain in Arithmetic in 1924.

A. A. '24 = Arithmetic Age of 1924.

SUMMARY

Arithmetic age as a basis of classification in a departmentalized scheme of classification results in grouping together pupils of a wide range of ability as measured by the various tests of ability. There was a range of 90 points in intelligence quotients, from 60 to 150 with a standard deviation of 15.5. In terms of arithmetical ability, as measured by arithmetic quotient, there was a range of 75 points—from 70 to 145—with a dispersion of

a standard deviation of 11.2. The mental ages of the group varied from 8 years 0 months to 13 years 8 months, with a standard deviation of 12.7 months. This extreme lack of homogeneity in terms of the other measures indicates that homogeneity can only be secured in the measure that is being used as a basis of classification.

A study of the composition of the arithmetic age of the Stanford Achievement Test reveals that pupils possessing the same arithmetic age in months may vary as much as two years in achievement in the separate processes of computation and reasoning. Equal gain in months in arithmetic-age during the year does not necessarily mean that the pupils have made equal gains in the separate processes of computation and reasoning. An excessive gain in computation may offset a small or negative gain in reasoning, and vice versa.

The use of the intelligence and arithmetic quotients as bases in classifying this arithmetic-age group into sections fails to secure homogeneity either in achievement or in ability. Ranges in achievement during the year's work were increased from eighteen months to over four years. There was present in overlapping between 44 and 59 per cent at the end of the year.

CHAPTER VI

PROGNOSIS IN ARITHMETIC

The solution of the problem of classification is dependent upon securing a predictive measure that is sufficiently accurate and reliable to serve as an index of a pupil's educational status at the time of classification, plus his ability to achieve during the next year. Every classification must be considered as a prognosis, a prediction on the part of the school administrator that the pupil will succeed in the next year's work.

This investigation has shown that for arithmetic alone no single measure under consideration furnishes an adequate basis for classifying pupils. Classification on the basis of any of these measures does not secure homogeneity in terms of either ability or achievement. An attempt was therefore made to determine a composite of these measures that would secure a better basis of classification than any of these measures considered separately.

The problem of determining an adequate basis for prognostication in arithmetic was attempted by applying the Toops Multiple Ratio Correlation Technique to the measures under consideration. This statistical technique is designed to determine the best combination of the factors under consideration for prognosticating a given criterion. In this study the arithmetic-age of the Stanford Achievement Test for 1925 was considered as the criterion, since this measure represents the achievement in arithmetic at the end of the next year's work. The following measures of 1924 were considered in an effort to determine the best possible composite that would predict this criterion: mental age, intelligence quotient, arithmetic age, reading age, chronological age, teachers' marks, and the number of days in attendance.

All of the 425 pupils in the fifth-grade classes were considered in this study. Table XXXIII indicates the correlation of each factor with the criterion and with each other. It is seen that

TABLE XXXIII

CORRELATION OF THE VARIOUS FACTORS WITH THE CRITERION ARITHMETIC AGE '25 AND WITH EACH OTHER

FACTORS	A. A. '24	A. A. '25	M. A. '24	I. Q. '24	C. A. '24	R. A. '24	Marks '24	Attend. '24
A. A. '24....		+0.703	+0.449	+0.489	-0.286	+0.353	+0.599	+0.066
A. A. '25....	+0.703		+0.526	+0.495	-0.237	+0.384	+0.525	+0.025
M. A. '24....	+0.449	+0.526		+0.784	-0.241	+0.316	+0.388	-0.002
I. Q. '24....	+0.489	+0.495	+0.784		-0.764	+0.676	+0.370	+0.028
C. A. '24....	-0.286	-0.237	-0.241	-0.764		-0.408	-0.160	-0.104
R. A. '24....	+0.353	+0.384	+0.316	+0.676	-0.408		+0.288	+0.035
Marks '24....	+0.599	+0.525	+0.388	+0.370	-0.160	+0.288		+0.123
Attend. '24....	+0.066	+0.025	-0.002	+0.028	-0.104	+0.035	+0.123	

A. A. '24 = Arithmetic Age 1924.

R. A. '24 = Reading Age 1924.

A. A. '25 = Arithmetic Age 1925.

Marks '24 = Teachers Marks in Arithmetic 1924.

M. A. '24 = Mental Age 1924.

I. Q. '24 = Intelligence Quotient 1924.

Attend. '24 = Attendance 1924.

C. A. '24 = Chronological Age 1924.

the best single basis in prognosticating the arithmetic age of the next year is the arithmetic age of 1924, the correlation being +0.703. The significant factors in addition to arithmetic age of 1924 were found to be mental age, reading age, and teachers' marks in arithmetic. The addition of these significant factors to the arithmetic age of 1924 produces a composite that correlates with the criterion +0.753, an increase in the correlation over that of the single arithmetic age of 1924 of 0.05. The formula which results is as follows:

$$I = 10 X (A.A. '24) + 4 X (M.A.) + 2 X (R.A.) + 3 X (Marks) + X.$$

I equals the criterion score, X (A.A. '24) the arithmetic age, 1924, X (M.A.) the mental age, X (R.A.) the reading age, and X (marks) the teachers' marks in arithmetic.

Mental age is the most important factor in addition to the arithmetic age of 1924 since it increases the correlation from 0.703 to 0.741. The addition of the reading age increases the correlation to 0.748 and the teachers' marks to 0.753. The contributions of the intelligence quotient, the chronological age, and the number of day's attendance were so slight as to be negligible. Their combined contributions increased the correlation with the criterion only one one-thousandth—from 0.753 to 0.754.

Thorndike¹ has formulated an interpretation of the value

¹Jordan, A. M. "Correlations of Four Intelligence Tests with Grades." *Journal of Educational Psychology*, Vol. 13, p. 429.

of a given correlation between certain factors and the criterion that suggests the inadequacy of a correlation of 0.70 as a basis for prognostication. This shows that for a correlation of 0.70, if it is desired to predict how many cases in each third of one series would be in the corresponding third in a related series, this number would be only 55 cases out of a hundred. A correlation of 0.90 as a basis for prognostication would place only 71 out of a 100 in the correct third section. Since the best possible combination of the tests being considered in this study gives a correlation of only 0.75, the inadequacy of the present measures as bases of classification is evident.

Another attempt was made to secure a basis for sectioning pupils that would progress at the same rate in arithmetic by using the number of month's gain for the year 1924-1925 as the criterion, and the following measures of 1924 as factors: intelligence quotient, arithmetic quotient, accomplishment quotient, and the teachers' marks in arithmetic. The best single measure in predicting the number of months' gain in the next year is the intelligence quotient, which has a correlation with the criterion of $+0.287$. By adding the accomplishment quotient, the correlation is increased to $+0.337$, while the addition of teachers' marks to this composite increases the correlation to $+0.355$. The contribution of the arithmetic quotient is insignificant, since it increases the correlation of the factors with the criterion only

TABLE XXXIV
CORRELATION OF THE VARIOUS FACTORS WITH THE CRITERION GAIN IN MONTHS AND WITH EACH OTHER

FACTORS	Gain '25	A. Q. '24	I. Q. '24	Marks '24	Acc. Q. '24
Gain '25 ...		$+0.131$	$+0.287$	$+0.170$	-0.278
A. Q. '24 ...	$+0.131$		$+0.449$	$+0.458$	$+0.131$
I. Q. '24 ...	$+0.287$	$+0.449$		$+0.370$	-0.405
Marks '24 ..	$+0.170$	$+0.458$	$+0.370$		$+0.088$
Acc. Q. '24 .	-0.278	$+0.131$	-0.405	$+0.088$	

four ten-thousandths. For purposes of prognostication this correlation is practically worthless as a predictive measure.

SUMMARY

The best single basis for prognosticating achievement in arithmetic for the next year is the arithmetic age of the present year.

This has a correlation with the arithmetic age of the following year of $+0.703$. A composite formed by adding the influence of mental age, reading age, and teachers' marks in arithmetic for the present year increases the correlation to $+0.753$.

The best single basis for grouping pupils into sections that will gain approximately the same number of months during the next year's work in arithmetic is the intelligence quotient. This has a correlation with the gain in months of the following year of $+0.287$. A composite formed by combining accomplishment quotient in arithmetic and teachers' marks in arithmetic with the intelligence quotient, increases the correlation to $+0.355$.

It must, therefore, be concluded that in the measures under consideration there is no adequate basis for prognostication in arithmetic.

CHAPTER VII

SUMMARY AND CONCLUSIONS

Classification, in terms of grade placement, of the total fifth-grade group on the bases of mental or educational ages did not greatly reduce the heterogeneity of the total group. The following table shows the comparison of the reduction in the ranges and dispersion of the other measures which results from using these ages as bases of classification.

TABLE XXXV

COMPARISONS OF REDUCTIONS MADE IN RANGES AND STANDARD DEVIATIONS
OF TOTAL FIFTH-GRADE GROUP BY CLASSIFYING INTO EIGHTEEN
MONTHS' GROUPS ON THE BASIS OF MENTAL AND EDUCATIONAL AGES

	M. A.			E. A.			C. A.		
	Range	Range in Months	S. D.	Range	Range in Months	S. D.	Range	Range in Months	S. D.
M. A.				10: 4-13:7	39	7.8	8:10-15:7	81	14.0
E. A.	8:11-14:10	71	11.0				9: 1-15:9	80	13.7
Total	8: 4-15: 7	87	12.4	9:10-14:0	50	8.7	8: 5-15:9	88	15.3

	R. A.			A. A.			I. Q.		
	Range	Range in Months	S. D.	Range	Range in Months	S. D.	Range	Range in Months	S. D.
M. A.	9:7-14:3	56	10.7	10: 3-14:6	51	10.1	70-135	65	12.3
E. A.	10:0-13:6	42	8.9	10: 0-15:3	63	9.8	65-145	80	11.9
Total	9:0-15:0	72	12.0	9:10-15:4	66	10.2	61-155	94	18.1

This indicates that for the pupils under consideration in this study any grouping that might be effected on the bases of the mental or educational ages would lack homogeneity in achievement in reading and arithmetic. The use of educational age results in the greatest reduction in range and standard deviation in reading, from a range and standard deviation for the total

group of 72 and 12 months to a range of 42 months and a standard deviation of 8.9 months. In arithmetic, using educational age as a basis reduces the range from 66 to 63 months and the standard deviation from 10.2 months to 9.8 months.

This investigation has shown that the educational age is the best basis for sectioning this mental-age group into more homogeneous sections in terms of ability and achievement in reading and arithmetic. This shows that for pupils making up the mental-age group educational maturity in the form of educational age is a better index of achievement than the "ability" measures. Classification on the basis of educational age places the educationally mature pupils in the X section, whereas, the accomplishment quotient places the educationally accelerated in the X section regardless of their maturity. With educational age as a basis of classification there was only an overlapping of 10 per cent in reading in 1924 and of 18 per cent at the end of the next year's work. In arithmetic there was an overlapping of 24 per cent in 1924 and of 38 per cent in 1925. The next best basis for sectioning the mental-age group was the educational quotient, which resulted in an overlapping of 22 and 24 per cent in reading, and of 56 and 49 per cent in arithmetic for the beginning and the end of the year.

A comparison of the differences between the reading and arithmetic ages of pupils of the same educational-age month shows that there is an average difference of nearly a year. The range between achievement in these subjects was from 0 to 61 months. This would indicate that, if the educational age of the Stanford Achievement Test is to be used as a basis of classification in grade placement, some provision must be made that will take care of these subject differences which exist within the individual pupils. Dividing into X, Y, and Z sections may adequately meet the problem arising from individual differences between pupils, but it does not solve the problem of subject differences within the pupils.

An evaluation of the bases of sectioning also shows that educational age is the best basis for dividing this educational-age group into sections in terms of ability and achievement in reading and arithmetic. The intelligence quotient was found to be the next best basis.

The arithmetic age as a basis of classification in a depart-

mentalized scheme of classification results in classifying pupils of a wide range of ability together as measured by the various tests of ability. This extreme lack of homogeneity in terms of the other measures indicates that homogeneity can only be secured in the measure that is being used as a basis of classification.

A study of the composition of the arithmetic age of the Stanford Achievement Test reveals that pupils possessing the same arithmetic age in months may vary as much as two years in achievement in the separate processes of computation and reasoning. Equal gain in months in arithmetic age during the year does not necessarily mean that the pupils have made equal gains in the separate processes of computation and reasoning. An excessive gain in computation may offset a small or negative gain in reasoning and vice versa.

Use of the intelligence and arithmetic quotients as bases in classifying this arithmetic-age group fails to secure homogeneity either in achievement or in ability. Ranges in achievement for the sections were increased during the year from eighteen months to more than four years. With these measures as bases, there was present an overlapping of between 44 and 59 per cent at the end of the year.

The study in prognosis in arithmetic shows conclusively the inadequacy of the measures of ability under consideration to predict the rate of gain in arithmetic during the next year.

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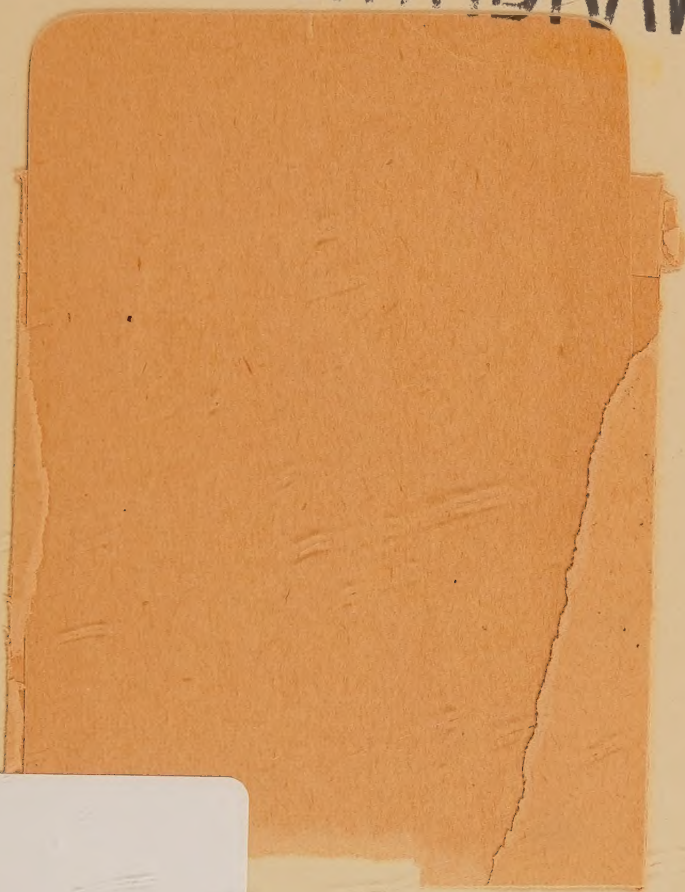
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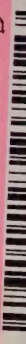
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